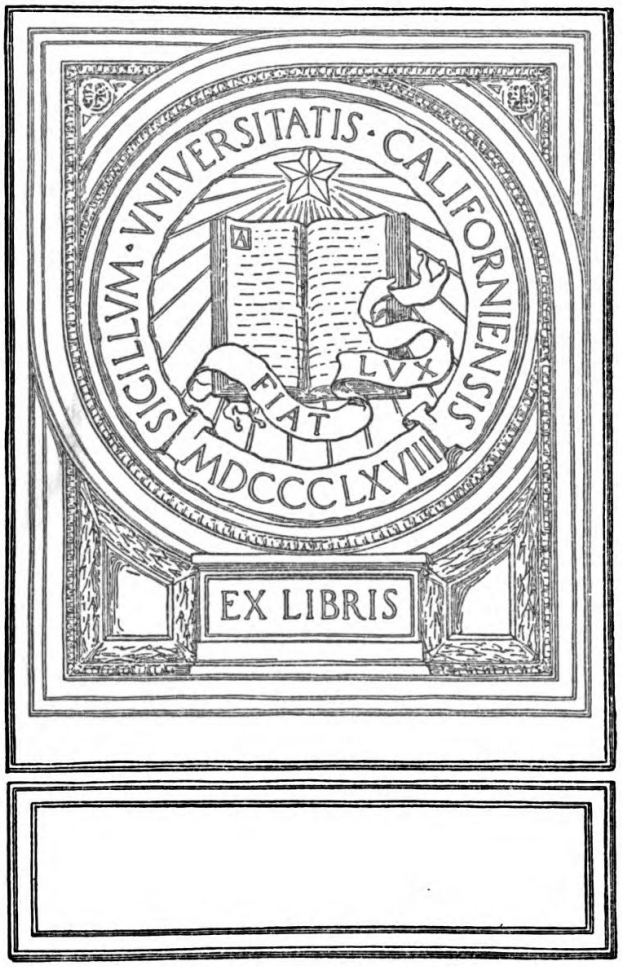
MEET THE PARACHUTE



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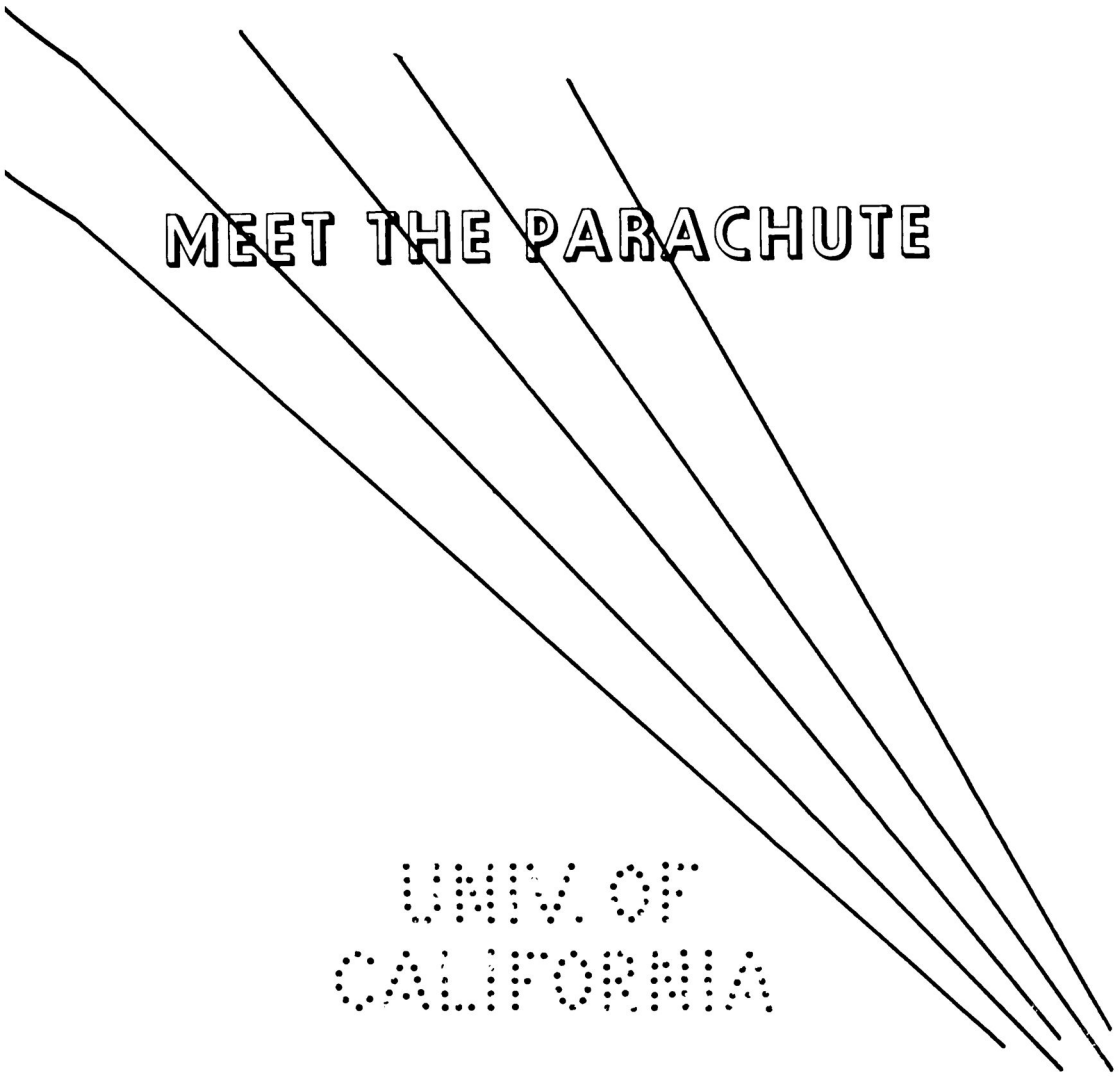


O. J. MINK, MANAGER, PARACHUTE DIVISION
RELIANCE MANUFACTURING COMPANY
CHICAGO, ILL.

Printed in the United States of America

FOREWORD

BY A. T. BARD

President

RELIANCE MANUFACTURING COMPANY

The parachute today is of interest to everyone . . . the rich and the poor . . . from the tiny child to the grandfather. To most of us, it's a fascinating subject but to the boys who use it, the parachute is a dynamic means of attack, a safe escape from danger, a refuge!

We are grateful for the thousands of requests from all parts of the country for our booklet, "The Interesting Story of Parachutes".

Because of the magnitude of this interest and because of the great future possibilities of the parachute, we have sincerely endeavored to publish a book which we hope will be entertaining and yet informative and an inspiration to all who read it.

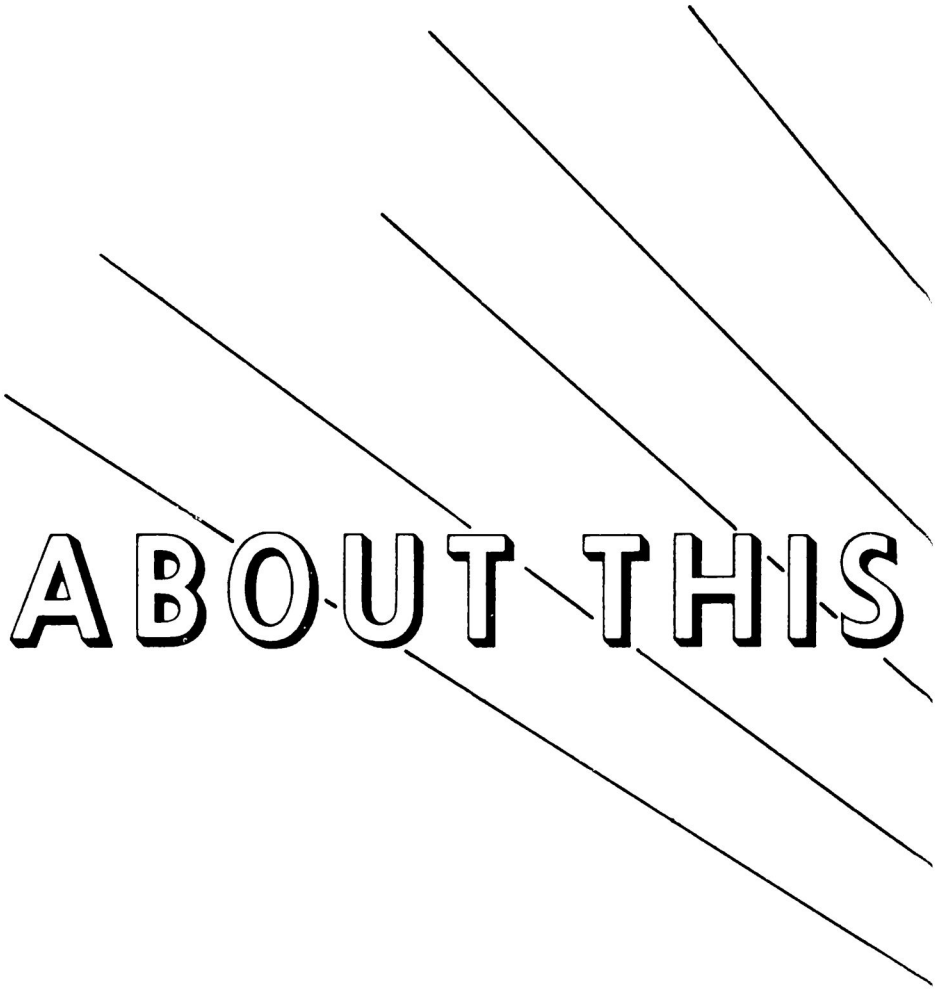
The Reliance Manufacturing Company is proud to present this book to you in its two parts . . . Book I—"Meet the Parachute"; its history, past, present and future. Book II—"The Use and Maintenance of the Parachute"; a manual for those in the profession.

This book is dedicated to the memory of Herbert G. Mayer, President of the Reliance Manufacturing Company (1930-1944), who himself a flier in World War I, knew the value of the parachute. His foresight and untiring efforts achieved for the company the reputation of being the country's largest manufacturer of parachutes and clothing for our Armed Forces in World War II. He found no task too small or too large to help his country, sacrificing his health, strength and even life itself to this end.

ACKNOWLEDGMENTS

We have not attempted to cite all the authorities and sources consulted in the preparation of this book. To do so would require more space than is available. The list would include Departments of the Federal Government, the libraries, industrial institutions and individuals. No one source has been relied upon; some of the historical facts may be controversial but we have endeavored to give the most authentic information available. We sincerely thank all these sources and we know they are proud of the part they have played in the development of the parachute industry.

O. J. MINK,
RELIANCE MANUFACTURING COMPANY
February 15, 1944
CHICAGO, ILL.



This is a book about parachutes, one of the most fascinating, valuable and promising of modern tools. It is prepared by a company that has worked closely with our Army and Navy Forces prior to the outbreak of World War II to perfect the parachute for its important military uses. That company is today the largest manufacturer of man-carrying, aerial delivery and cargo chutes in the country.

BOOK

It is written for all who are interested in flying: the flier, to whom the parachute represents an indispensable hold on life; the technician, whose responsibility it is to know how the parachute works, what is necessary to insure its infallible operation; and those who find the glamorous story of man's conquest of the air inspiring reading.

The greatest development of the parachute has come within the last decade. Development is still going on. The Reliance Manufacturing Company is proud to be taking part in that evolution.

This book does not attempt to present specific types, which may be now undergoing improvement. It is, instead, a more general survey of the parachute as a tool by which man can not only save life, but enrich it. This review includes something of the parachute's history, its uses today, its care and proper handling. Vast and wonderful possibilities lie ahead of it in the world to come.

PRIME MINISTER CHURCHILL AND GENERAL LEE INSPECTING PARA-TROOPERS AT FORT BENNING, GA.
(Note: Reliance Chutes)

1

THOSE DARING YOUNG MEN

When first Russia, then Germany began dropping armed troops from the air a new form of invasion was added to the age-old strategy of war, a new word to the military vocabulary. The whole world at last became intensely aware of the parachute.

It had taken a long time. The records, though vague, indicate that the parachute has actually been in use for six hundred years. It seems to have been man's first challenge to the forces of gravity, and was the forerunner of the balloon and then the airplane. What makes its story intriguing is the way in which the parachute has eluded its destiny.

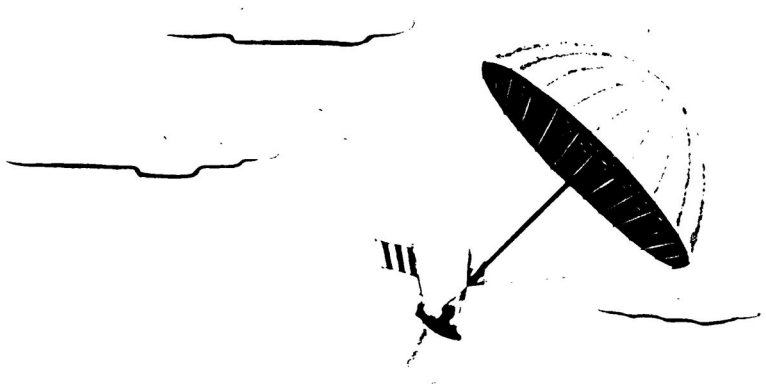
The primary purpose of a parachute is to save human life. Many of its earliest users, though their experiments were limited to high towers and housetops, risked much to prove that a human being, though catapulted from dangerous heights, need not necessarily die. Nevertheless, in this basic role, the parachute actually came into general use only after the airplane itself had reached comparative perfection. It took the Second World War, introducing vertical invasion and the paratrooper, to drive home to the general public that the parachute is an essentially practical device, offering unlimited opportunities.

For this we must thank its inventors. Evidence found in the historical archives at Peking, China, and translated by the French monk, Vasson, indicates that they were Chinese. Even without records, we might have suspected it. The relation between the

parachute and the umbrella, which we know for a Chinese invention, is obvious. Whereas the umbrella is and always has been an eminently practical device, the Chinese apparently first used the parachute merely to dangle acrobats above the amazed and, no doubt, highly edified guests at a court ceremonial. Thus was launched a tradition from which, unfortunately, the parachute has only recently made its escape.

There is nothing vague about our next introduction to the parachute. The notebooks so thoughtfully kept by Leonardo da Vinci, versatile genius of the fifteenth century, reveal, in black and white, the first parachute ever committed to paper, a pyramid-shaped structure by which, should occasion arise, a man might leap from a tower without undue danger to his life! Whether or not his pyramid would actually accomplish this purpose neither da Vinci nor we know. Apparently it never went beyond the model stage. The idea was an intriguing one, too good to die with its creator. Almost a hundred years later we find it again, enbalmed in a book on machines by a Hungarian mathematician living in Italy, one Fauste Veranzio, who not only left us drawings of his apparatus but also described for us several successful trial jumps he had made from a tower in Venice.

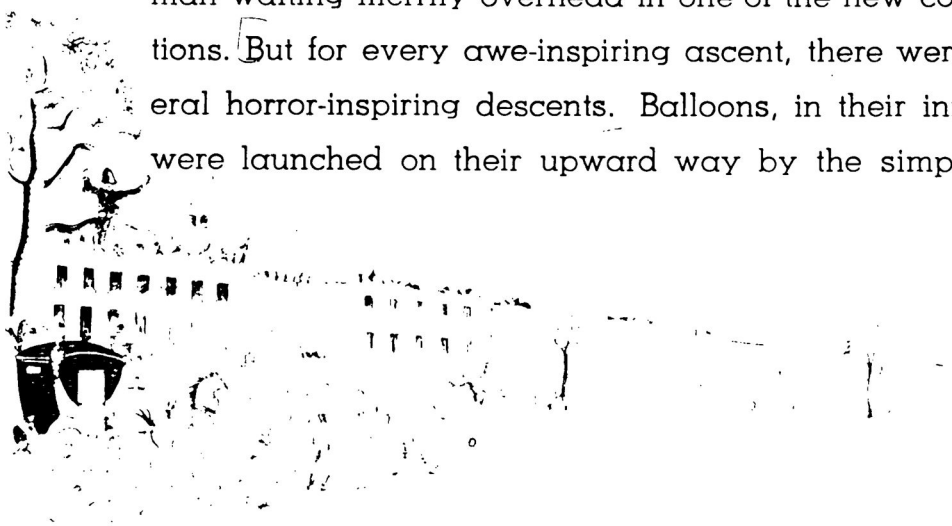
For Veranzio's claims we have no other authority than his own. Greater authority attaches to the experiments of the Frenchman Joseph Montgolfier, who, late in the eighteenth century began putting some of the current scientific findings to practical use. After prolonged experiments with hot air, cloth and courage, he launched the first balloon. Whether the purpose of Montgolfier's work with the parachute was to make the balloon possible or to



save his life if he didn't, we do not know. We are fairly certain, however, that he went so far as to test the device he evolved by dropping a number of animals from various towers. He afterwards jumped himself, not only from the roof of his home at Annonay but later from greater heights and before large crowds.

However far Montgolfier actually carried his parachute, it is certain that his balloon gave it sudden and practical impetus. Within only a few years after the balloon had been established, another Frenchman, one Sebastian Leonomard, made a successful parachute jump from Montpelier observatory. His feat deserved, and gained, wide publicity. So did his announced purpose — to demonstrate that it was not necessarily fatal for a man to be trapped in a burning tower!

Burning tower — burning balloon! Obviously Leonomard had something. The balloon meanwhile had caught public fancy. In no time at all it became common to see some daring young man wafting merrily overhead in one of the new contraptions. But for every awe-inspiring ascent, there were several horror-inspiring descents. Balloons, in their infancy, were launched on their upward way by the simple ex-



4

pedient of building a good hot fire under them, filling the bag with its necessary quota of hot air. As a result, many an exhuberant balloonist, out to thrill the crowd, horrified it instead, by making his ascent in a cloud of smoke and the stench of burning fabric, inevitably, falling to swift and grisly death.

Such events did not seem to cool the ardor either of the balloonist or of his fascinated audience. But they did point to the parachute as a possible means of saving lives. This trend was accelerated late in the eighteenth century when Jean Pierre Blanchard, one of the most famous balloonists of the day and the first man to soar boldly out over the English Channel, interested himself in the device. After trying it successfully on his dog, Blanchard made several jumps himself.

In 1785, in an exhibition balloon ascent over the city of Ghent, Blanchard's balloon became so overinflated that he had to make immediate choice between having it burst over him or puncturing it and entrusting his life to his parachute. The latter course brought him to earth, shaken, but, except for a broken leg, intact. The parachute had risen to its first emergency and saved its first life!

Enthusiasm grew. But its direction was questionable. The parachute had rescued its first balloonist. It would undoubtedly save more. Meanwhile neither the public nor the daring young men could wait for another emergency. Parachute jumps for the sake of the jump became part of every balloon ascension show. People forgot that the parachute could save a life as they watched the performer use a parachute to risk his life.

6

The greater the height, the greater the risk and the greater the thrill. At the turn of the century Andrew Jacques Garnerin, who achieved fame by the number, daring and success of his jumps, tried out a new type of parachute, one made of silk panels sewn in the shape of an inverted cup, before a large gathering of titled English in London. Dazzled by the size and importance of his audience, Garnerin waited to cut his parachute loose until he had reached the prodigious height of eight thousand feet. Here was daring! Never before had man jumped from so high. Breathless and fascinated, his audience watched. Here came Garnerin, his white umbrella blossoming against the sky. Then things began to happen. Only a few seconds after the jump, the umbrella began to tip from side to side, swinging Garnerin like a pendulum below, more and more wildly, until he was pitching wildly to and fro.

The experience was hard both on Garnerin and on the parachute. From the paneled parlors of the rich and erudite to the pubs and street corners, controversy raged. People wrote letters to the papers and to the politicians. Scientists offered profound treatises. What made the thing act that way? What, if anything, could be done about it? And when were human beings going to resign themselves to staying on the ground and give up flying in the face of Providence?

Garnerin, having regained his equilibrium, set to work to find the cause of these discouraging gyrations. The English scholar, Sir George Cayley, proposed as a remedy a cone-shaped parachute, used with the tip pointed down. This idea was developed and, according to his report, used with success by the German, Lorenze

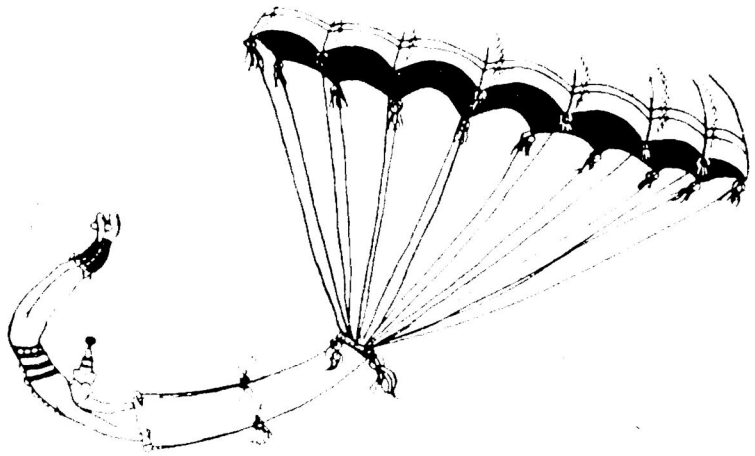
Hengler. Hengler, in fact, made several jumps from heights of one to four hundred feet "without experiencing the least discomfort."

In 1837 an English artist named Robert Cocking borrowed Hengler's idea for his own. Experiment since had proven that the inverted cone parachute is essentially sound in theory. In Cocking's version, used at five thousand feet and probably because its construction was insufficiently strong to support its two hundred pound weight, the cone disintegrated in mid-air, flinging its unfortunate author to his death. Both he and his parachute had been widely publicized as the solution to the strange behavior of Garnerin's parachute. As a result, his death, instead of solving anything, merely succeeded in sustaining public disbelief and disapproval.

So great was public antagonism by this time, that it was adamant against more successful ventures. The French astronomer Lalandes, figured it was the air trapped under the canopy and spilling out first under one side and then the other that caused oscillation. He solved the problem by the simple means of providing an opening at the peak of the canopy which permitted a constant and steadying flow of air upward. This was the first vent. It worked. Meanwhile, the Polish balloonist Jordaki Kuparento used his parachute to leap safely from his flaming balloon over Warsaw. People were not impressed. Even the leading balloonists of the day were loud in their disapproval, among them the famous American aeronaut, John Wise. After experiments with both the umbrella and the cone parachute, he apparently turned his back on both, allowing his balloon twice to explode in mid-air to demonstrate that it was easier to float safely to earth with no

other paraphernalia than the fragments of his damaged balloon!

After a brief but promising start, the parachute receded to the position the Chinese had established for it. It became merely a contraption by which the circus acrobat and carnival performer thrilled his audience. When the excitement of seeing a fellow mortal risk his life wore off, ingenious trapezes were rigged to the chute and the daredevil threw in for his money hair-raising aerial feats. When that no longer sold tickets, enthusiasm was temporarily revived by selling jumps to the more courageous among the audience. In this role the parachute early in this century passed its six hundred year mark.



EVOLUTION OF AN IDEA

Many people remember 1908 and the first airplane. Theoretically, the airplane should have immediately established the parachute in its primary role of life saver. Custom does not relinquish its hold quickly or easily. Those who saw the airplane through its hazardous infancy, did so without benefit of any but the most remote hope of survival should their experiments go awry. When men — and women, for women were by now prominent among our aerial performers — did start using the parachute to jump from airplanes, the incentive seemingly was not so much to perfect a means of saving life, as to break records!

Here was a bigger thrill! It was one thing to jump from comparatively low altitudes and from a gently moving balloon. It was quite another to jump from a craft traveling as high and fast as the airplane. Changes in technique were necessary, and changes in the parachute itself. Thus the airplane launched a series of scientific experiments to make the parachute more airworthy. The purpose still was dubious. But the results were everybody's gain.

It is amazing that, despite such experiments, the parachute is today basically what it was at its origin. The fundamental function of a parachute is to reduce the speed at which the load falls through the air, offsetting the pull of gravity which would otherwise dash that load to destruction. This it does simply by multiplying many times the air resistance offered by the load alone. Thus, the parachute is as fundamental a device as the sail.

10

It is safe to presume that the first Chinese parachute was umbrella shaped. Anyone who has carried an umbrella in a high wind will recognize its effectiveness. Obviously it worked for its inventors. Modified, it is working for us today.

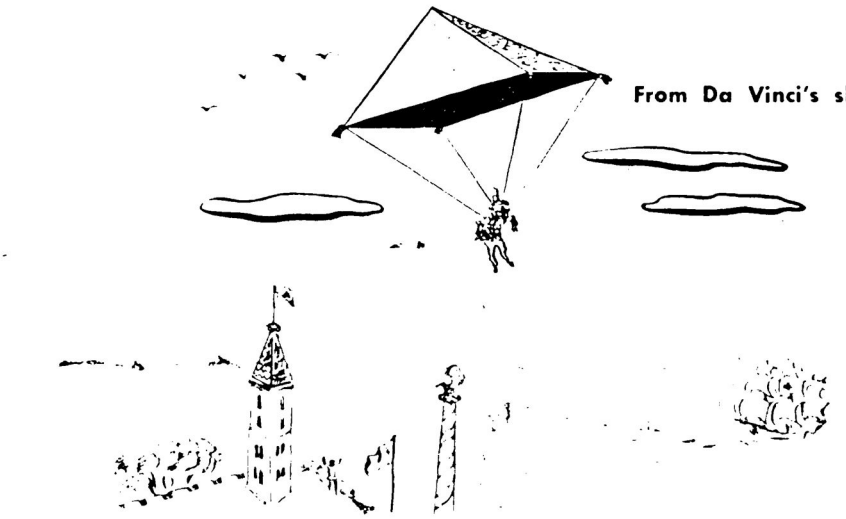
Da Vinci's parachute, however, consisted of four triangular pieces of cloth joined to form a pyramid, from which various ropes extended to support the jumper. In the Codex Atlanticus, 1495, he added details: "If a man have a tent roof of calked linen, twelve braccia broad and twelve braccia high, he will be able to let himself fall from any height without danger to himself." Substitute yards for braccia, and you can visualize it. Presumably, it would have worked, at least to a degree.

Veranzio jumped with a square of linen held rigid on a wooden frame. The jumper held onto four cords, one attached at each corner. Veranzio says it worked. Nor can we doubt him. The parachutes first used to drop supplies to parachuting forest fire fighters were mere squares of burlap, without the wooden frame but with the four corner suspension lines. Experiment to date has proved, with some variation in characteristic performance, triangular and even oblong canopies may well have a role in the future. One shape makes up in maneuverability what it lacks in stability. Choice depends on which shape is the greatest asset for the particular load to be carried.

When that load is a man, the modified circular umbrella-shaped parachute offers the greatest number of advantages. This is the shape specified by Army and Navy Air Forces today. Variations of the circular chute have been proposed, one of them, known as the hemispherical chute, shaped like an apple

cut off just below the bulge and complete even to the familiar indentation where the stem grows. This shape, too, has honorable antecedents. There is evidence that it was first proposed as early as Da Vinci's time. Today, combined with present-day knowledge of materials, design, it provides the advantage of unusual stability.

The parachute with which Garnerin made his controversy-provoking jump was umbrella-shaped and, like the umbrella, reinforced by a central stem. This, at the time, was a revolutionary departure from the canopy held open permanently on a rigid framework. It was one of the many factors seized upon and subsequently abandoned in current efforts to solve the problem of oscillation. Further experiment, and a successful jump by a Frenchman named Bourget at Berlin in 1804, proved that a completely collapsable chute was not only practical but certainly much more convenient to carry around. It could be folded when not in use and relied on air pressure alone to hold it open. We now take the collapsable chute for granted. Without it, we should never have been able to put the parachute to any practical use.



From Da Vinci's sketch book

12

Garnerin's parachute was made of thirty-two panels, so shaped that the umbrella was produced merely by sewing them together. In this respect it was no innovation. The general scheme for constructing the parachute canopy is, like its shape, almost traditional. Garnerin's umbrella was only twenty-three feet in diameter. This, in those days, was comparatively small and again became the subject of attack. Man early turned his attention to establishing the exact proper relationship between the size of the canopy and the weight it must carry. An oversized canopy slows up the rate of descent by building up more air resistance, but it is also inclined to dent in the wind and become uncontrollable. Minimum canopy size is limited by the speed at which it is safe for a load to fall.

The standard man-carrying chute in service is twenty-four feet in diameter, the width proven most suitable for the 180 to 200 pound weight of the average man. The paratrooper's number one chute is twenty-eight feet in diameter. Since the paratrooper most often jumps at a comparatively low level, it is essential to his safety that he fall at a slower rate. His emergency chute, however, need be only twenty-two feet in diameter. Although the twenty-four foot chute is now standard equipment, twenty-two feet is the minimum size considered safe. Chutes for dropping supplies are sized according to the weight of the load they are meant to carry. Experiments to date have successfully used canopies one hundred feet in diameter to lower weights of over ten thousand pounds! In recent tests at Wright Field, clusters of forty-eight foot parachutes have been used to lower successfully loads ranging from four to ten thousand pounds!

Unlike Garnerin's, however, the modern man-carrying parachute has an eighteen to twenty-four inch opening at its peak. This vent, together with the scientific development of parachute materials, is very important to its success.

As the canopy descends, more and more air builds up inside of it, so that some air must constantly be escaping to make room for new air being forced in. Part of this air necessarily spills out under the lower edge of the canopy. As the extended canopy tilts in the wind, or as the load swings into position below it after the jump, more air is spilled out at the up side than at the down. The load then obeys the laws of balance and swings in the opposite direction, the air spilling out the opposite side. Without any means to counteract it, tipping and swinging tends to increase rather than to diminish. Oscillation has been one of the parachutist's greatest problems.

A certain amount of oscillation is almost inevitable in a descending parachute, but it needn't be either unpleasant or dangerous. The vent, allowing a large volume of the captured air to escape directly upward, minimizes the motion. Not only is less air left to spill out under the skirt, but the steady vertical column of air upward tends to counteract the oscillation that would otherwise be set up.

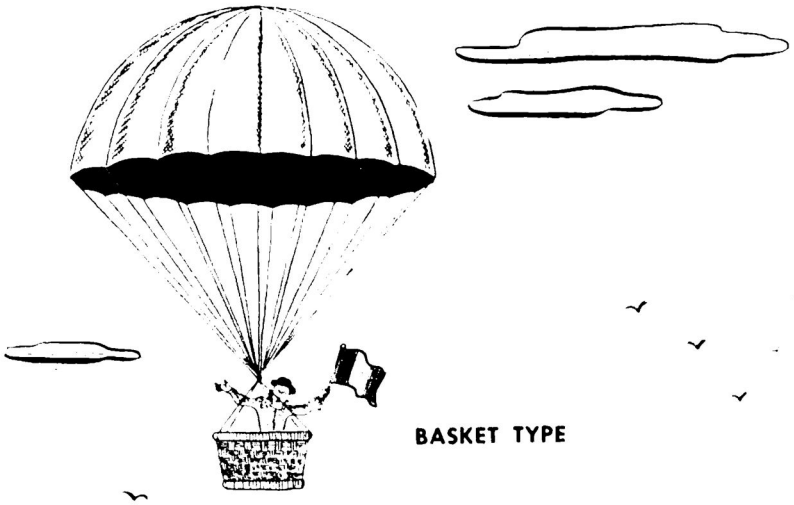
Since a vent of any size reduces the air resistance which the canopy affords, if it is not properly calculated, it tends to increase the speed at which the parachute falls. Vents are sometimes equipped with a sort of sleeve, which, gathered onto a rubber ring, reduces the size of the opening without offsetting its effect. Some of the flare-carrying parachutes, which must hang

steady in the sky but should stay there just as long as possible, have a long straight sleeve which retards the escape of air upward without stopping it. The man-carrying chute has for the most part abandoned this extra device, relying on design, proper materials, correct size to accomplish a safe speed, permitting the vent to do its full duty.

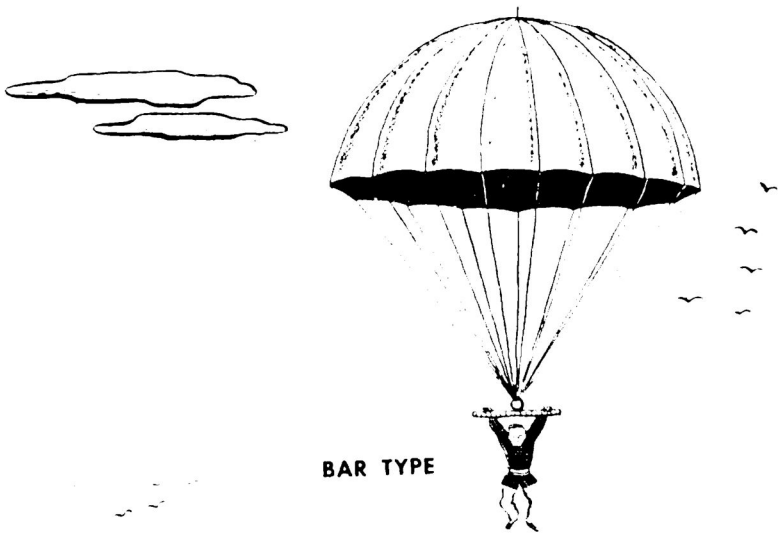
Early parachute jumps, because of their relationship to the balloon were universally made in a basket which was a smaller counterpart of that carried by the balloon. Often the jumper sat grandly in his basket from earth to sky and back again, his canopy extended above him all the while, merely cutting an attaching cord when the time came to free himself from the balloon.

Gradually, both to save weight and to increase the attraction of the act, the basket was replaced by a trapeze. Now the jumper sat precariously on a mere bar, or even somersaulted or chinned himself as he descended. In 1887, Captain Thomas Baldwin, an American jumper of much renown and the first in this country to demonstrate the use of a collapsable chute with a vent opening, carried this trend to its ultimate conclusion. Baldwin's chute was equipped with a wooden ring!

When the airplane put emphasis on height rather than tricks. it became necessary to develop a surer means of attaching a man to his hold on life. Exhibition jumpers might still perform on trapeze bars. Saner men began to study the harness as the most promising means both of supporting the jumper while he was in the air and of permitting him full use of his body to break the shock when he came in contact with the ground. Today's harness is designed accordingly. To put it on, the flier merely pulls it in



BASKET TYPE



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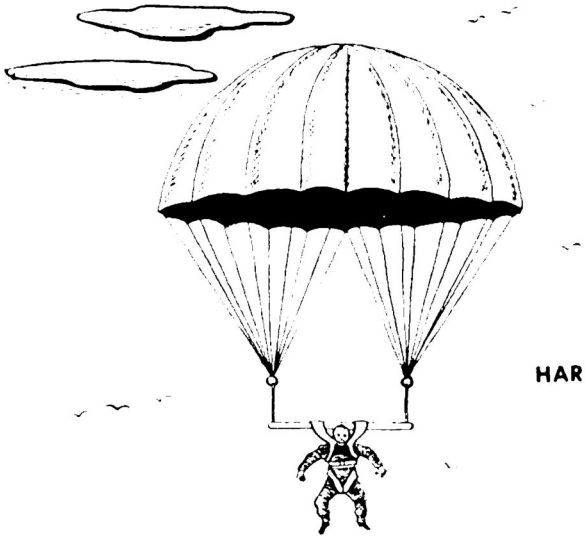


HARNESS TYPE

place over shoulders and thighs, snaps three fasteners, makes two adjustments to bring it to a safe and comfortable fit and he's set. He may never have more intimate experience with a parachute than that. The life-saving parachute seldom sees action. But if he does jump, his first hardship occurs when the canopy snaps open. It may take two long seconds after he has left the ship for that to happen. When it does happen, it's sudden and hard. It's a shock. His harness is designed to absorb that shock. It does this by distributing the jolt to four parts of his body, the thighs and shoulders. In addition, it is shaped to form a sort of sling under his seat, by this means encouraging a proper position when falling, hips bent and knees drawn slightly up, giving him more support than if he were merely dangling.

In 1890 Paul Lettemann and Kaethe Paulus, German exhibition jumpers, demonstrated the first use of parachutes folded and packed in bags. Their innovation grew out of a special act, a double parachute jump, in which the performers left the balloon by means of one parachute, then made a second jump with a second parachute. Such acts delighted the public. The jumps grew to as many as ten in succession. In such jumps it was necessary to assemble each parachute and its parts separately and to provide a means of keeping that assembly intact until the very moment it was sent into action. A bag-like container was the solution.

The container idea did not take hold immediately. Grant Morton, some believe, was the first man to jump by parachute from an airplane. The airplane was only three years old when Morton went up over Venice Beach, California, and safely de-

scended before admiring crowds. Morton jumped with a folded silk parachute which he carried in his arms and cast into the air as he left the plane.

Another claimant for that honor, Captain Albert Berry, in a famous exhibition jump over the St. Louis parade grounds, used a thirty-six foot parachute equipped with a trapeze bar. Berry's chute, however, was packed in a metal cone-shaped case underneath the fuselage. At twenty-five hundred feet Berry made his way down the axle of the plane, grasped the bar and jumped. Thus, Berry was certainly among the first to jump from an airplane with a parachute carried in what may be considered one of the forerunners of the modern parachute pack.

That such men were successful, that they were jumping from ever higher altitudes with constantly improved equipment, did little to convince the public that the parachute was anything but the means of getting a thrill. Nor was the early aviator much help. He, too, and not without reason, considered himself a daredevil and a public performer. The parachute jumper quite naturally seemed to him merely questionable competition. And in this view, he was often aided and abetted by the parachute itself. Experiment in those days produced many grotesque and some completely unworkable designs, including canopies that opened by means of a stream of compressed air to others that leaped open with springs. A succession of fatalities did nothing to inspire public assurance or to sell the aviator on the idea that the parachute was something on which he would eventually depend on to save his life. It took war to do that.

THE PARACHUTE COMES INTO ITS OWN

1914, only two years after Berry made his jump with the pack-type parachute, brought World War I!

As in the Civil War, balloons went immediately into action. They were used on all fronts for observation purposes. In the Civil War, a balloon anchored behind the firing line was comparatively safe. In World War I it soon proved an easy target for enemy planes. Within a year both the Central Powers and the Allies were equipping their balloons with parachutes.

With emphasis now on its ability to save life rather than merely to thrill spectators the balloon parachute swiftly underwent suitable change. Originally attached under the basket, it had long since moved up and was hitched by a release line to the equator of the balloon envelope, so that it dangled where it could be reached from the basket at a moment's notice. Later an adaptation of the pack-type parachute was adopted, packed in a conical container which was fastened outside the basket and within easy reach. It is estimated that this type of parachute, alone, saved the Allies nearly a thousand lives in the first World War.

Lives were precious. But even more precious upon occasion were the papers, photographs and instruments usually carried in the basket of a balloon on duty at the front. Eventually a parachute was devised which saved not only the crew but the entire contents of the balloon basket. It was carried in a container imme-

diately below the balloon envelope and attached to the suspension lines by a release mechanism. This could be manipulated, when the moment came, to free the basket and permit it to descend safely under its parachute while the damaged balloon went off to its fate in whatever direction the wind carried it.

Meanwhile, the very planes that threatened the balloons were themselves proving vehicles of almost certain death. The romance that has subsequently been built up around the planes which initiated aerial warfare could not have been so very apparent to the young pilots who flew them. "Crates" they were, in reality as well as in jest, flimsy contraptions of wood and canvas, likely to disintegrate in mid-air of their own vibration and so exposed that a single machine gun bullet might prove fatal. With every plane lost, pilot and crew inevitably met their death. The need was as urgent as it was obvious. The parachute had saved lives. It would save more.

At last, under the cruel necessity of war, the parachute came into its own. In 1916, an Austrian pilot used his parachute to escape from a burning plane on the Russian front. Three months later another Austrian pilot made a safe landing from another disabled plane. By 1917 both Germans and English were madly equipping their air forces with parachutes. By the summer of 1918 parachutes were in general use on all fronts.

These earliest life-saving parachutes were basically the bag-type chute. The German version was the Heincke Sack Type parachute; the English, the famous Guardian Angel. Both, at the time, represented the latest developments. They were attached to the flier by means of a harness. So attached, the bag-type

parachute, when not in use, became a sort of cushion. From within its bag, the canopy was attached by a static line to the plane. When the flier jumped, it was automatically pulled out and into position for action.

By modern standards the parachute used in World War I was but a makeshift contraption. Nevertheless it formed the basis for most of the experiments which were carried on immediately after the war and since. The automatic Guardian Angel, for example, is immediate ancestor to the automatic parachute carried by the paratrooper today. The introduction, shortly after the war, of a parachute operated by the flier, launched a controversy which has not entirely died down even to this day. And though there is little seeming resemblance between the modern parachute pack and the clumsy bag of those days, the one, nevertheless, owes much to the other.

The experiments which have perfected the modern parachute, actually were under way even before the first World War was over. General William Mitchell, commander of the U. S. Air Forces in France, had long been sending frantic pleas back home for more and better parachutes for his men. As a result, in 1918, the necessary money was allotted by the government to set up personnel and equipment for scientific experiment at Wright Field, Dayton, Ohio, today materiel procurement headquarters for Army Air Forces, and the hub of our military parachute program.

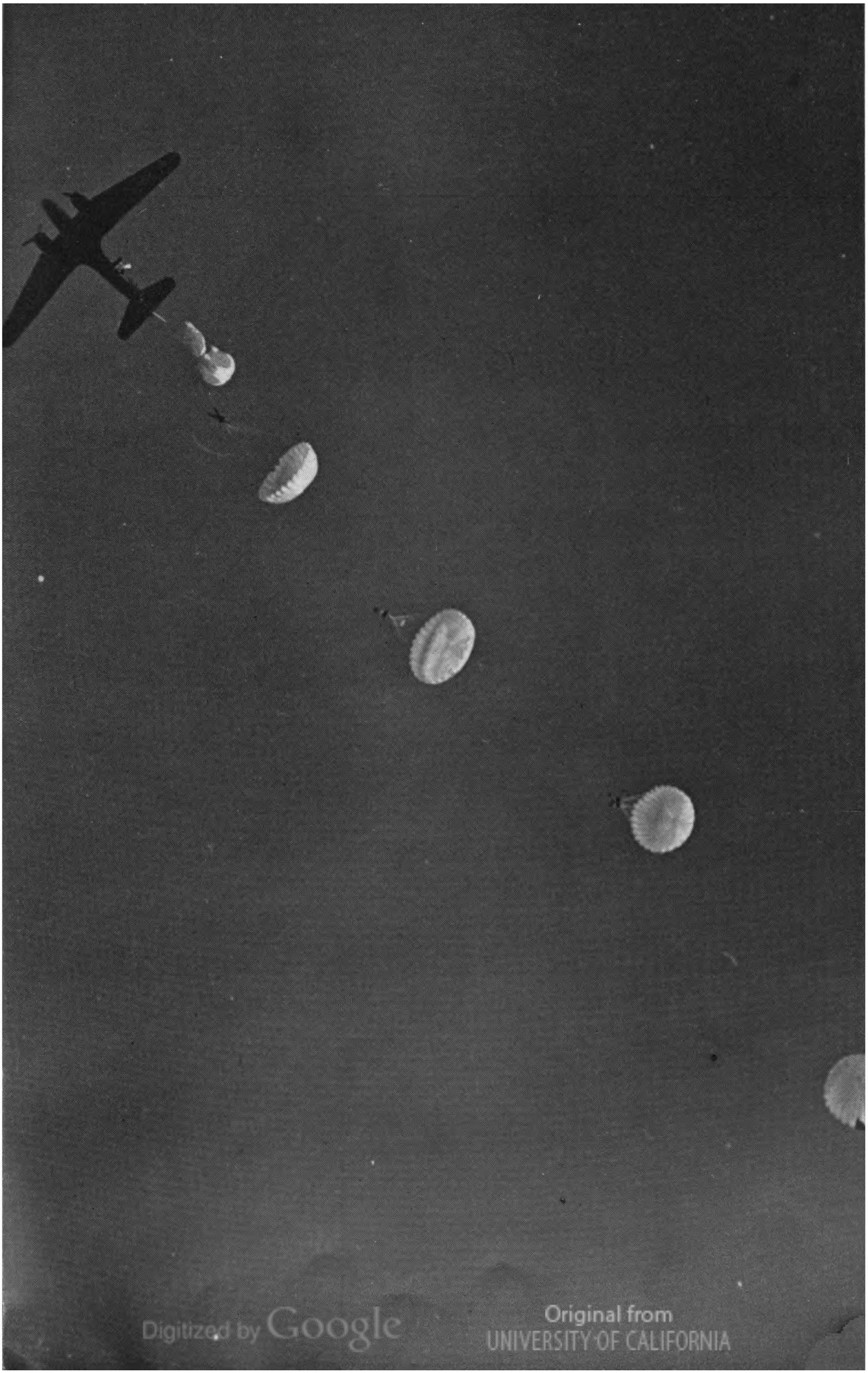
One phase of the development thus made possible is the parachute pack. The Heincke and the Guardian Angel both employed a seat-type pack. This same type is standard for U. S. Army Fliers today. The pack itself has been vastly modified and

refined to guarantee; first, quick and positive canopy opening and, second, maximum comfort for the wearer. It is today a flat square of canvas which the flier wears like a cushion.

Other type packs, however, were early developed as the need arose. For personnel which must be constantly on the move within the plane, back and chest packs permit needed freedom for the arms and shoulders. These are the types most regularly worn by bombardiers and aerial photographers. For use in smaller planes, where the space available for each flier is limited, there is the chest or quick attachable pack, with which the harness only is worn and the pack is kept close at hand, ready to be snapped on.

Each of these standard types has proven itself over and over in actual use. The ultimate parachute pack is yet to come. Experiments with a garment pack point to one possibility. Designed especially to relieve gunners working in big military planes of discomfort and weight, this consists of a strongly reinforced flying suit or flight jacket with the harness built in and the canopy folded in a minimum of space over the back, where it provides not only a cushion but extra warmth.

One of the earliest effects of the parachute pack was to limit the choice of canopy fabrics. Da Vinci's parachute was made of linen. Garnerin used silk. Some of the earlier sack-type parachutes were made of cotton. The specific qualities which make one fabric more suitable than another, however, had been given little scientific study. But as soon as the canopy is folded into a pack, bulk in addition to other qualities must be considered. Even the modern twenty-four-foot parachute canopy involves



some sixty-five square yards of material in addition to seven hundred feet of suspension line.

A time-honored quip among aircraft engineers specifies as one of the greatest needs of aviation a material "with no weight. no mass and infinite strength." Even were such a fabric within the realm of possibility, aviation would still lack the ideal parachute cloth. Parachute cloth must possess high tensile strength. The moment of greatest strain on all parts of a parachute comes when the canopy suddenly fills with a tremendous volume of air and snaps open. At this moment canopy cloth must have more than strength. It must also be sufficiently elastic to absorb the energy of the opening shock without breaking and to resume its normal shape immediately. Thus elasticity is also a prerequisite of suitable parachute cloth. In it "strength" is a proper combination of maximum tensile strength with maximum elasticity.

For many years silk was the favored parachute fabric. When hostilities with Japan ended our silk supply, however, the government turned to the man-made fabrics which, though some of them were first introduced as substitutes for silk, had long since earned a place of their own in civilian use. Rayon was one of these. Many of our latest supply-carrying chutes and others are made of rayon. But today the vast majority of man-carrying chutes — canopy, pilot chute and suspension lines, are made entirely of nylon.

In making this exchange we have gained much. Nylon was first perfected in 1938. Nevertheless all of us are more or less familiar with its basic properties. Nylon, derived chemically from coal, air and water, is crystalline in its composition and thus

absorbs so little water that it dries with amazing and satisfying rapidity. This is a tremendous advantage for the woman who washes her stockings each night. It is an even greater advantage for a parachute which, used in all kinds of weather and often for landings in water, must be completely dry before it can be re-packed. Nylon not only has amazing strength, but is so tough that it resists snags and abrasions. Such strength is a boon to everybody who uses it, especially to the parachutist, who must count on his parachute to take a considerable amount of abuse and to save his life. Nylon is highly elastic. Though it stretches easily, it also returns quickly to its given shape. In a parachute canopy this elasticity is an essential quality. In nylon all this is obtainable in a fabric of feather-weight and gossamer sheerness. You can actually gather several yards of nylon parachute fabric in one fist!

Each of these qualities is a tremendous contribution to the modern parachute. Because nylon is man-made, it is possible to control exactly the size, strength and uniformity of each yarn. In the ideal parachute cloth a certain amount of air must be permitted to escape through the pores of the material. Because of these exact controls, the porosity of nylon cloth can be adjusted exactly as needed. Nylon, too, is affected by few liquids. A silk parachute carried into the sea must immediately be washed in fresh water lest the salt water start to deteriorate it. Nylon is

COTTON + SILK + COAL + SCIENCE = PARACHUTE

impervious to salt water. It is resistant to many of the other causes of deterioration which attack a parachute in the ordinary course of its existence. Like silk, it is as strong wet as dry. Unlike silk, it is resistant to the fungi responsible for mildew. Much of the life of the ordinary life-saving parachute, is spent either in storage or in the pack. Not only is nylon resistant to moth damage, but, though it deteriorates about as rapidly as silk in the sunlight, it shows no appreciable deterioration in the dark. While nylon will melt in contact with flame, it will not itself burst into flame.

Though nylon is the standard fabric for the man-carrying parachute today, this fact does not necessarily indicate that it is the final and ideal parachute fabric of all time. Experiments even now are under way with another man-made material, Fortisan, which is proving itself in many respects equally suitable for the manufacture of parachutes.

In another phase, experiment at Wright Field early ran into the automatic versus manual free-type parachute. The automatic type had proven itself in World War I. It was only natural to presume that the first objective was merely to improve it. To this end new designs were solicited. Germany sent over the latest Heincke chute. In testing, the canopy failed. England sent a special representative to demonstrate her newest Guardian Angel. The Guardian Angel of this period was attached to the jumper's harness by a life line. In the test jump, this line broke, sending the demonstrator to his death. While neither incident had direct bearing on the validity of the manually operated chute, both paved the way for the acceptance of an alternate. When

A GOOD VIEW OF A PILOT CHUTE

the manually operated chute was proposed as that alternate, there were many objections. Could a man hurtling through space have sufficient presence of mind either to time his fall or to operate the mechanism which opened his canopy? Several successful test jumps answered that one. A more serious objection remained. How, unless the canopy were mechanically pulled from the pack, could one be absolutely sure that it would open at all?

In 1911, an Italian named Pino had offered the first pilot chute. It consisted of a small parachute canopy, held open on a frame and worn on the aviator's leather helmet. When the aviator jumped, this pilot chute not only removed the helmet but also pulled the main canopy from the pack. Germany had experimented with this idea late in World War I. The pilot chute was perfected as the means of guaranteeing the manually

operated canopy sure and speedy opening. Today it is merely a miniature version of the canopy proper. Unlike the main canopy, it is equipped like an umbrella with steel ribs which spring open the minute the pack is released by the jumper's pull on the rip cord. The little pilot is shot into the air, drawing the main canopy out of the pack after it. With more recent improvements in both the pack and the canopy, opening has been made so sure that the pilot chute is today no longer essential to safety. It is still used, nevertheless, as an additional safety factor.

Once the major objections against it were met, the free-type parachute was adopted with enthusiasm. Both automatic and free types are now in service. The choice depends on the use to which the parachute is to be put. For training purposes the automatic chute undoubtedly inspires a healthy confidence. All the wearer has to do is jump. His parachute does the rest. The paratrooper wears both. His regular twenty-eight-foot chute is the automatic type, attached by static line to a strong wire cable inside the plane before he jumps, so that his own weight pulls the canopy from the pack and the opening is accurately timed and sure. This is a distinct advantage when jumping at a low altitude, when it is necessary for the canopy to open and slow his fall as quickly as possible. When many instead of just one jumper are involved, it permits the group to descend as a group and to make an almost simultaneous landing within a limited area.

The paratrooper carries also a manually operated parachute which he may use at will. The chief advantage of this free-type chute is that it gives the user some control over the

time at which his canopy opens. Especially in an emergency jump, he may have little choice over the part of the plane from which he leaves. The plane may be burning or dropping death-dealing fragments. In such cases, the jumper can wait to open his canopy until he is sure he is in the clear.

U. S. PARATROOPER

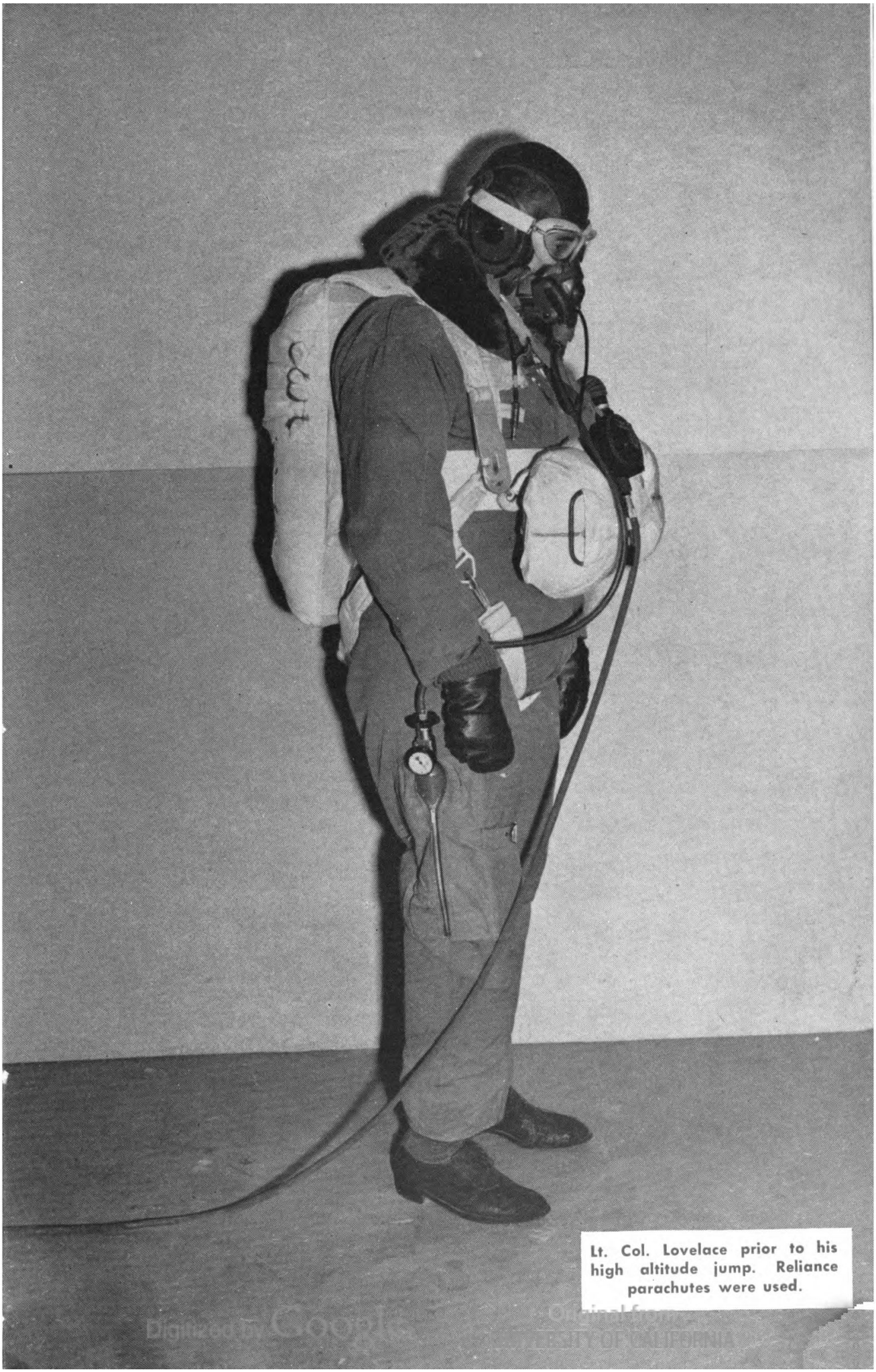
The advantage of a delayed canopy opening increases with the altitude of the jump. In a high wind, for instance, the longer the jumper can fall without his canopy, the less distance he is likely to be carried from his destination. If he is making an escape under enemy fire, also, he is a much less conspicuous target if he is falling rapidly without benefit of canopy than if he is descending more slowly, with his canopy pointing out his whereabouts. At extremely high altitudes, where diminishing air pressure and extreme cold enter the picture, a delayed opening, enabling him to fall as quickly as possible to levels where he can breathe and keep warm, may be his only chance of survival.

30

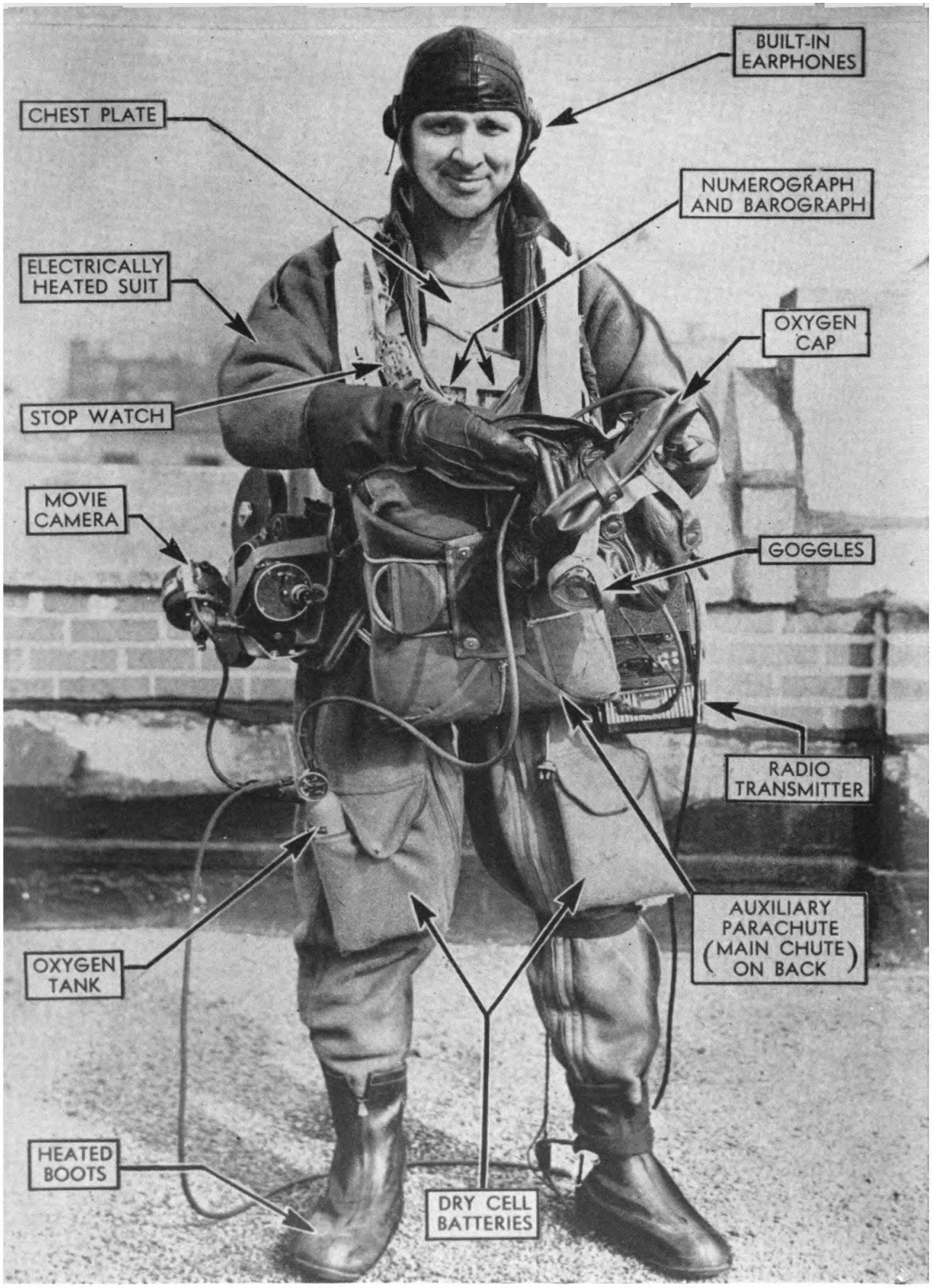
High altitude jumping is in its infancy. As the airplane climbs higher and higher, an understanding of the problems involved becomes more and more necessary. No man has yet jumped from the stratosphere. The highest jump recorded in this country is that made only recently by Lt. Col. Randolph Lovelace to test the emergency oxygen equipment furnished army airmen. Using a Reliance parachute — proving its reliability for high altitude as well as low altitude jumps —- Lovelace bailed out at 40,200 feet. To date the record jump of all time is that made by the Russian parachutist Kharkohonov in August, 1940, from 40,813 feet. Both are close enough to indicate that stratosphere jumping is not only possible but probable.

The most rewarding high altitude jump to date, however, was that of the American, Arthur H. Starnes, in the summer of 1942 at Chicago. In spite of previous experimental high altitude jumps the whole subject was still more or less shrouded in mystery and doubt. As a stunt, the thing was possible. But as a practical procedure. . . . . ? What happened to a man dropping like a plummet through freezing nothingness? Scientific tests in compression chambers simulating the air conditions in high altitudes were good as far as they went. But they did not go far enough. The airplane was rapidly making the stratosphere its own. Could the stratosphere flier rely on the parachute to save his life?

Starnes determined to find out. So that his findings would be scientific and final, he carried with him some eighty-five pounds of intricate scientific instruments. Certain equipment had already become customary for the pilots of high altitude planes



Lt. Col. Lovelace prior to his high altitude jump. Reliance parachutes were used.



Arthur H. Starnes with the special suit and equipment used in his historic five and one-half miles "free" fall.

and had been successfully adopted by the first high altitude jumpers. It included electrically heated clothing to keep him warm while he fell through sub-zero space, and an oxygen bail-out bottle to permit him to breathe until he reached the altitude at which the air became thick enough to sustain human life. This altitude is generally set at 18,000 feet. A man breathes about two quarts of oxygen a minute. Thus, if a parachutist left a plane equipped with an oxygen bottle containing only thirty-eight quarts, he was safe for nineteen minutes. In nineteen minutes he can fall a long way. Even if he jumped from 40,000 feet and opened his canopy immediately, he would reach the safe 18,000 foot level in about fifteen minutes. If he waits to open the canopy, he reaches this level much more quickly. The usual emergency pocket oxygen bottle is only about the size of a flashlight. Nevertheless, it provides a good margin of safety.

In addition to such equipment, Starnes carried other instruments to record every aspect of his jump. Through them his fall was recorded as to speed, altitude, and air pressure changes. A radio transmitter strapped around his waist broadcasted his heartbeats, a pneumograph registered his breathing. A radio transmitter and earphones built into his helmet permitted him to describe his sensations for the benefit of watchers below and an automatic motion picture camera fastened to his right hip so that it pointed downward, recorded his view.

Starnes jumped from approximately six miles in the air -- 30,800 feet. A stop watch timed his fall at only one minute and fifty seconds. This was because he waited until he had fallen five and a half out of those six miles -- was, in fact, only six

seconds from the ground before he pulled the rip cord. His instruments showed that the opening of the canopy checked him from a speed of one hundred and thirty miles an hour to about 13 miles per hour. The shock, naturally, was intense. Starnes reported a brief blackout. Otherwise, except for the frost collected on his goggles in a cloud bank through which he passed at 23,000 feet, he arrived safe and smiling. Starnes demonstrated once and for all that, except for the jitters a novice might well experience on such a jump, it actually need have no adverse effect upon the jumper. Most important of all, he established for all jumpers to come one of the chief advantages of the delay in canopy opening made possible by the manually operated, free-type parachute.

To what extent people will be jumping from comparable heights in the future is anybody's guess. Progress in stratosphere flying before the war is bound to be continued after it. Groundwork has already been laid to take high altitude jumping out of the professional class and give the amateur a chance. As early as 1938, the Doronin brothers of Russia introduced an automatic parachute which opened not with a static line but with a timing device which could be set before the jump to delay the opening just as long as seemed desirable. The ultimate parachute may be one which opens either automatically or manually, so that the jumper may make his own choice according to the circumstances!

DOWN . . . TO BUSINESS!

The first World War established the parachute as a means of saving life. It is in this role that most of us think of it today. As such, it is required equipment for every member of the military who goes aloft. The installation of parachutes in passenger planes, more or less in the experimental stage before the opening of the Second World War, will undoubtedly become universal after it. As civilian air travel increases, more and more of us are bound to become familiar with the parachute. It will become as commonly known as the life belt.

As soon as its value in this respect was accepted, other uses for the parachute became immediately apparent. Many of these were military. By 1919, parachutes were already being used to insure the safe landing of military supplies dropped by plane, and to drop saboteurs behind the lines. Not until the outbreak of the Second World War, with its startling headlines about paratroops and vertical invasion, did the world become aware just how steadily and how intensely and how far these original military uses had been carried forward.

Meanwhile, out of those very military uses, there have sprung many peacetime uses, some of which came into being and have been developed to signal success with so little fanfare that the general public is not even aware that they exist. There has been much talk recently, about how small this world has grown. It contains thousands of miles of territory remote from railroads and

Russian nurses dropped by parachutes.

highways, or locked away by mountain barricades or belligerent weather. To people living in such regions, the airplane offered promise of a needed link with their fellows, the parachute fulfilled it.

Russia discovered this use early. In Russia, as in our great Pacific Northwest, tremendous sections of country lie not only inaccessible to ordinary means of transportation, but totally without facilities for landing airplanes. For years Russia has supplied such localities with food, medicine and other essentials via parachute, and, when the emergency has demanded it, even with doctors and nurses! In principle this use of the parachute has vast possibilities. It is a positive means of bringing relief to the victims of flood, tornado, earthquake and shipwreck. It is an expeditious way of supplying light houses, remote islands and observation posts. It suggests, moreover, the development of regular supply services which may revolutionize the life of people living in the out-of-the-way places of the world.

Just how such services may operate has already been demonstrated. Today Air Mail service is unavailable to large portions of our population, either because they live off the regular air routes, in communities whose size does not justify installation of necessary equipment for landing planes, or where flying conditions are chronically unsatisfactory. One such region, surprisingly, is in the Appalachian area of the East. Today regular Air Mail deliveries are accomplished there by the simple means of dropping off the mail pouch from a low-flying plane, at the same time picking up an out-going pouch from a line suspended between two poles by means of a boom extending from the plane.

This is a good and safe method for letters, but not for breakables and larger packages. These are safely lowered near the same poles by parachute.

The use of the parachute in aerial delivery suggests that it may help to promote needed exploration of those parts of this world still unknown. This use has already been proven on recent expeditions in New Guinea, in the Yukon, and by a group exploring the mysterious heights of Shiva's Temple in the Grand Canyon. The most ambitious test was provided by the Wood-Yukon Expedition exploring the St. Elias range near the Canada-Alaska boundary in the summer of 1941.

Many things besides accidents can defeat a body of men alone in unknown and hostile country. In the far north especially, where the more friendly summer season is brief and every hour of daylight counts, time is as vital to success as food and proper clothing. The time customarily consumed in forwarding supplies by foot or horseback as the party advances can well be the deciding factor in whether or not the party reaches its goal at all, or, if it does reach it, in whether or not it can make the expedition pay in its yield of scientific knowledge.

Plans for the Wood-Yukon Expedition consequently included the landing of supplies not only at a base camp but at various other posts decided in advance along the way. The procedure itself, carried out with the cooperation of two U. S. Army B-18-A bombers and their personnel, was comparatively simple. Bases were carefully located on aerial maps and photographs. Supplies were packed in stout wooden cases, which, lest they be carried along the ground by the parachute and damaged, were

freed from the suspension lines with the first impact by a blasting cap. A red flag mechanically erected itself as the case descended, to insure as far as possible its being located easily by the explorers. Over a thousand pounds of supplies were landed, at least ninety-five percent of which were successfully recovered and used. In several cases, the parachute failed, because the chutes assigned this task were old, retired from active service as unfit for human use. One case, because the natural landmarks had shifted since the map was made, required a search. A few had to be located in the snow and dug out. The last lay just where it had been dropped forty-six days before, intact and useable. In 1939 it had taken sixteen days to transport eleven men and the necessary equipment over the glacial ice of this same area. The two Army bombers took care of the equipment in two and one-half hours!

The full extent to which the parachute may help in advancing scientific knowledge lies in the future. In another role it has been aiding science for a long time. Because weather conditions at high altitudes are frequently the forerunner of weather conditions down here, all our progress in the fine art of weather forecasting has been upward.

At the turn of the century, it was customary to make advance observations by sending up balloons. Instruments were developed, attached to the balloon, recording temperature, humidity and wind direction all along its ascent. In order to insure the safe return of the balloon and secure the record made during its ascent, it was necessary to keep it under control. The heights at which weather observations could be taken were limited,

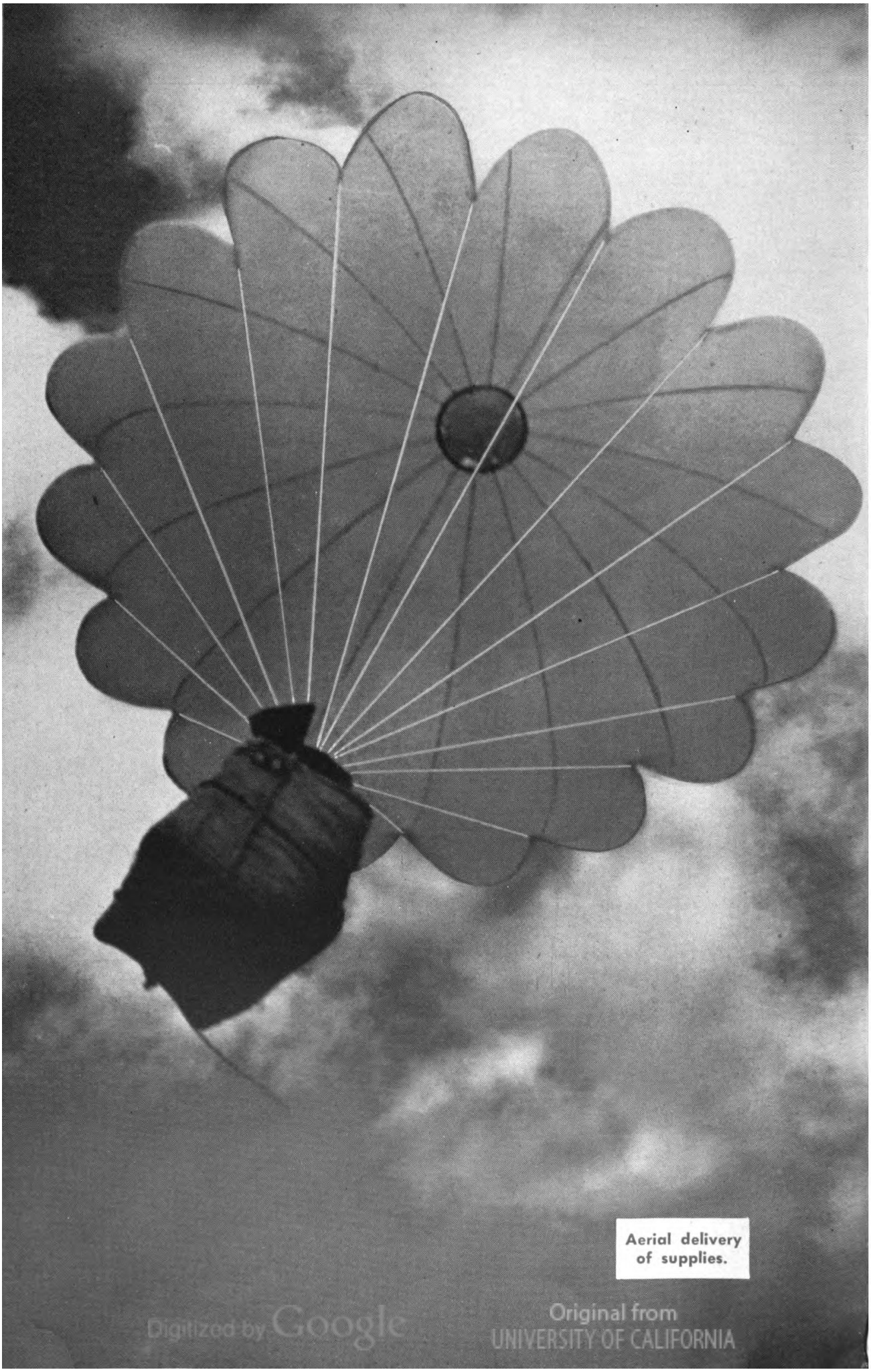
With the advent of the radio, a new instrument was devised which solved part of the problem by transmitting its recordings by air wave to the weather station below. The radiosonde is a remarkable device, quite expensive, less than two pounds of delicate precision mechanism in a plastic case. The problem of getting the weather recording instrument safely back to the weather bureau still remained.

The solution is the parachute. As the small balloon raising the radiosonde to position ascends and the air grows thinner, the helium gas with which the bag is filled expands, until, at a certain height, the balloon bursts. Immediately a fifty-four inch parachute goes into action, slowing and stabilizing its precious burden against the pull of gravity, carrying it safely to earth. Its route downward and its ultimate landing place, of course, cannot be controlled. But a message printed on the case, offering a reward for its return to the weather bureau, has resulted in a very satisfactory record of recovery.

Another significant use for the parachute has been developed by the U. S. Forest Service. In fighting forest fires, speed may make all the difference between success and failure. The difficulties of placing men and equipment where they will do the most good are often tremendous. Many of our fifteen million acres of valuable timber are remote from any means of transportation. While the difficulties of transportation are being painfully solved, the blaze may gain such headway that any control is impossible.

In 1934 the Forest Service began a series of experiments near Ogden, Utah, to test the feasibility of dropping supplies to its

Fire fighter from the U. S. Forest Service.



Aerial delivery of supplies.

fire fighters at the scene of action. For this purpose, it used square burlap chutes tied at the corners and good for fifty to one hundred pounds. In 1939 further experiments were conducted at Winthrop, Washington, one of the seventy-six landing fields maintained by the Forest Service. This time they tried dropping not only equipment but men.

A special parachute was developed thirty feet in diameter and equipped with an apron over the vent to increase maneuverability and enable the jumper to land as closely as possible to his destination. He had also a special detachable harness which he could throw off quickly when he made a "featherbed" landing in a tree top. In case he landed too near the scene of the fire, he wore a two-piece duck suit heavily padded for protection, a football helmet with a steel mesh wire mask and a high padded collar.

His is a thorough and valuable course of training, not only in the techniques of fire fighting and of keeping alive in the forest but in the use of a parachute under hazardous conditions. It proved itself during the summer of 1940, when these crews of "smoke jumpers" went into action for the first time in the Nez Perce National Forest region, showing that the new technique was not only more effective but much more economical. Simultaneously it became also an invaluable national asset. During the same summer the role of the parachute in the new World War had become already apparent.

That role was a versatile one. As far back as 1931 the German, Hans Steiner, in his book on the parachute (Der Fallschirm) designated the parachute as the means of supplying fighting forces with "ammunition, explosives, weapons and spare

parts, signalling apparatus, cable, steel cylinders, gas masks, instruments, building materials, tools, carrier pigeons in padded cages," as well as to carry, "messages, orders, maps, drawings, plans, photographic plate developed in the plane while in flight, provisions, clothing, water, medicine and surgical dressings, smoke producing devices, flame throwers, floating mines and flares." The list does not include the paratrooper. In 1931 Germany was apparently not yet committing herself in this respect. In dozens of ways, some not yet permitted publication, on every front, the parachute is serving well.

It serves importantly, for example, in supplying American, British and Fighting French troops in the difficult terrain of North Africa and in Europe. Military supply chutes are green, blue, red or yellow. Their colors have a most practical purpose. They signal to men on the ground what type of supplies are on their way down. Green parachutes may designate medical supplies; blue, ammunition; yellow, food. By this means the waiting troops can secure the type of supplies of which they have most urgent need. To prevent the enemy from catching on and upsetting carefully laid plans, the color code is changed daily. Green may mean medical supplies today, food tomorrow.

Since early in the war, the parachute has laid magnetic mines, thousands of which have been sown in the coastal waters of Norway, Denmark and France by expert British fliers. Other parachutes are used to stay bombs dropped from planes, so that the plane can escape having the bomb explode directly and disastrously under it.

One of the most common of present day military uses of

the parachute is also one of the oldest. The Chinese are again responsible. When your giant Fourth of July Roman candle goes off, stringing its lights like flowers against the sky, what holds them there? Parachutes, of course.

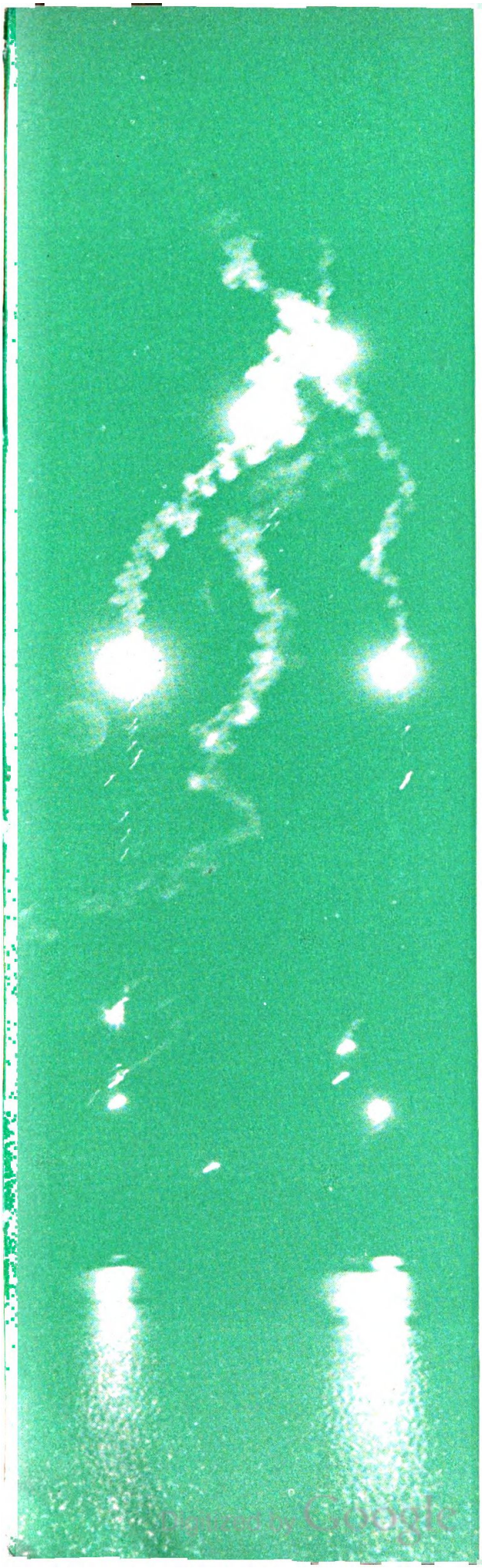
Illumination is one of the greatest problems of night flying. It is the only means by which the pilot can safely land in a small airport, or make an emergency landing in strange terrain. Searchlights attached to the plane have disadvantages. If the plane is flying at high altitude, the light dwindles before it reaches the objective. If it is flying sufficiently low for the light to break through, it reveals the landscape only in confusing strips. If the plane is disabled, chances are it may not work at all. If the plane is a combat plane, in the thick of enemy fire, a search-light beam is like a finger pointing invitingly to its source.

Civilian and commercial fliers early adopted the parachute flare. It is standard equipment on all military planes coming in many different types. Some burn for a comparatively long time and give nearly a million candle-light power, enough to illuminate the darkness for an area of approximately a square mile. These are the flares with which military pilots get their bearings in preparation for night attacks. Other flares burn more briefly, just long enough to give the pilot a quick glance around without being detected. Some blaze but a minute and are gone. Some of these, synchronized by a sort of electric eye with a camera in the plane, make night photography possible. Others are used as signals. They burn in colors, making it possible to show color combinations and so to transmit orders simultaneously to large, widely scattered troops.

When such flares are dropped from a plane, a timing mechanism may be used to prevent their opening until they are far enough away from the plane not to point out its position to the enemy. Others take the form of light bombs, which ignite by a percussion cap when they hit the ground. Some flares are shot from guns on the ground or sent up like rockets, which explode high in the air. In all, a parachute delays their natural downward sweep and prolongs their usefulness.

Flare parachutes are smaller than man-carrying chutes, their size depending on the weight they must carry. They are equipped with a drag sleeve to slow their descent and with a small glass fiber shade, which looks like a little gray umbrella when opened, designed to protect the eyes of the fliers from the glare. As packed for use, sleeve, parachute, shade and flare chemicals and firing mechanism rest together and in the order named within a metal cylinder equipped like all modern projectiles with exterior flanges to steady its direction when released. When the container is released, the drag sleeve emerges first, pulling out the parachute and shade and starting the fuse. By the time the fuse has lighted the flare, both canopy and shade are open.

The full use to which the parachute is being put in World War II is not, of course, known. Some of its uses can be imagined. If an entire plane can be safely landed by parachute, experiment proving that it can, why can't the larger weapons, tanks, for example, be similarly dropped into battle? The possibilities are vast and thrilling. Put them together with the present uses and others which are promised, infinite combinations result.



Then add to them the most spectacular use of the parachute which this war has developed, that of dropping men as well as materials where they are needed, when they are needed. The place to be occupied by the parachute in the better world to come begins to take definite shape.

Flare Parachutes

VERTICAL INVASION

Benjamin Franklin, viewing the exploits of the balloonist in France during his stay there as American Ambassador, drew some very pertinent conclusions. "Five thousand balloons," he wrote, "capable of raising two men each could not cost more than five ships of the line; and where is the prince who could afford so to cover his country with troops for its defense as that ten thousand men descending from the clouds might not in many places do an infinite deal of mischief before a force could be brought together to repel them?"

Benjamin Franklin was an American. Some of the most important developments in "heavier-than-air" transportation can be claimed by America. The Wright brothers who invented the airplane were Americans. An American made the first airplane flight across the Atlantic ocean. The free-type manually operated parachute had its origin and gained its first acceptance in America. One of the earliest demonstrations of the landing of armed troops by parachute was inspired by our own General William Mitchell. Yet, when it comes to foresighted and practical exploitation of the parachute, we must retire in confusion before the achievements of other countries.

The military advantages gained by the employment of parachute troops are fairly obvious, even to the unitiated. Success in most military operations goes to the side which does the completely unexpected first. Thus speed and secrecy are weap-

ons in almost the same sense as a tank or a high caliber gun. Large scale troop movements are necessarily more or less cumbersome, even in a highly mechanized war, their speed limited by the very mechanisms which convey them, their progress complicated by problems of supply and terrain and seldom kept completely from the enemy.

The airplane went far to increase both speed and secrecy. Complete conquest can seldom be accomplished from the air alone. The Italian island of Pantellaria capitulated as the result of fierce air bombardment. It was the first example in history of a new form of conquest. Similar examples have followed. But, in most cases, occupation is what the word implies. It entails actual possession of the territory involved. One doesn't just set an airplane down in hostile country.

The employment of paratroops carries the advantages of aerial warfare just one necessary step further. It permits the transport of large numbers of armed men at top speed. It enables them to be carried over enemy territory, over enemy lines and into strategic positions otherwise inaccessible, furnishing them with the inestimable weapon of surprise.

Arriving over its destination, the plane's motors are cut and it glides to a low level. Silently, often in complete darkness, the men spill out. Frequently they can accomplish a good begining on the task assigned them before the enemy is aware that they have landed. In actual practice, this task is often to pave the way for reinforcements scheduled to arrive by troop plane later. It may be merely a matter of cutting barbed wire and clearing a landing field. It may involve overcoming enemy guards and

destroying their defenses. In other cases paratroops themselves have acted as reinforcements, landing behind the scene of battle to sustain hard-pressed units. By no means the least of their contributions have been performed in small groups or individually, in small tasks of sabotage and intelligence, each vital to the success of a larger campaign.

The whole story of paratroop activity in this war cannot be told until it is over. Nevertheless even such meager information as we now have indicates that its part is a big one. France, for example, organized a first battalion of air troops in 1938, abandoned it in 1939, just prior to her downfall. Czechoslovakia was "interested", but postponed action until independent action was no longer her prerogative. Both Russia and Germany, however, were training paratroopers long before the war started.

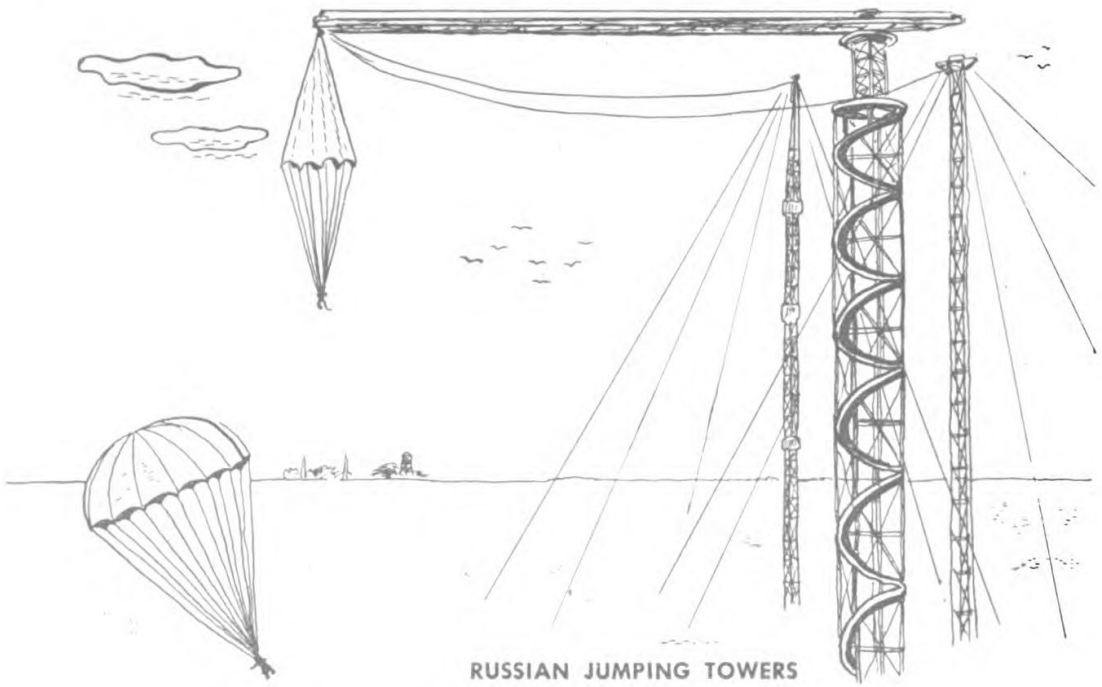
The achievement of Russia is the most amazing. For almost twenty years after her Revolution, the world knew little about what was going on in Russia. Then, suddenly, at her 1930 Sports Festival, she treated the world to the spectacle of armed men jumping from an airplane by parachute to occupy the "headquarters of the enemy"! And just how long, asked the world, has this been going on?

Not for long, apparently. Russia's interest in the parachute actually is much younger than ours. Her first recorded jump, made by the national hero Gromov, occurred in 1927. Russia is quicker than we to grasp at all opportunities. Since then she had adopted parachuting as her own, and on a national scale.

In 1933, as a means to make the entire Soviet air-minded, an organization called the Osoaviakhim was formed under gov-

ernment sponsorship, ostensibly to promote sports and other recreational activities among the young workers of the U. S. S. R. Actually it promoted parachuting, with such success that branches sprang up like mushrooms all over the country, every park, carnival ground and town square soon boasted its jumping towers—a small one for the children, full-sized ones for adults—and parachuting became to the Russian a more common form of diversion than skiing is to us!

In 1935 Russia showed the world what she had accomplished in a film of army maneuvers. In 1936 foreign missions were invited to witness maneuvers themselves at Kiev, and saw whole battalions of jumpers descending in mass from the blue, among them many women. At this time there were five hundred and fifty nine parachute towers in Russia and one hundred and fifteen training stations. By 1940 Russia could boast one million trained jumpers.



RUSSIAN JUMPING TOWERS

Russia also put her trained army of parachutists to work early. She used them to supply remote communities with food, mail, medicine. She used them to fight forest fires. Russia was the first country to drop parachutists into the snow and send their skiis by parachute down after them. And when war came, Russia was in this respect well prepared. Russian paratroopers, white clad to camouflage them against the snow, went into action in Finland in 1939. They represented the launching of a brand new idea in warfare, one which other nations were quick to seize and put to their own uses.

Germany's paratroop program was under way as early as 1935, when, having disavowed the military restrictions placed against her by the Treaty of Versailles, she began to carry on in the open military preparations which apparently had secretly been under way for some time. Not the least of these was Germany's development of her air forces, and the exploiting of both the glider and the parachute. Experiments were launched immediately at Staaken Airdrome, involving the investigation of both mental and physical effects of jumping by the Research Departments on Military Psychology and the German Medical Corps.

Early in 1936, Germany issued its "Instructions on the Formation of Parachute Troops" and established a training school at Spandau. Fifty trainees were later sent to gain practical experience first hand with the Spanish Condor Legion—German expeditionary force in Spain. Of these, twenty-three were lost, but the rest were utilized to further the training of more parachutists in methods of actual warfare.

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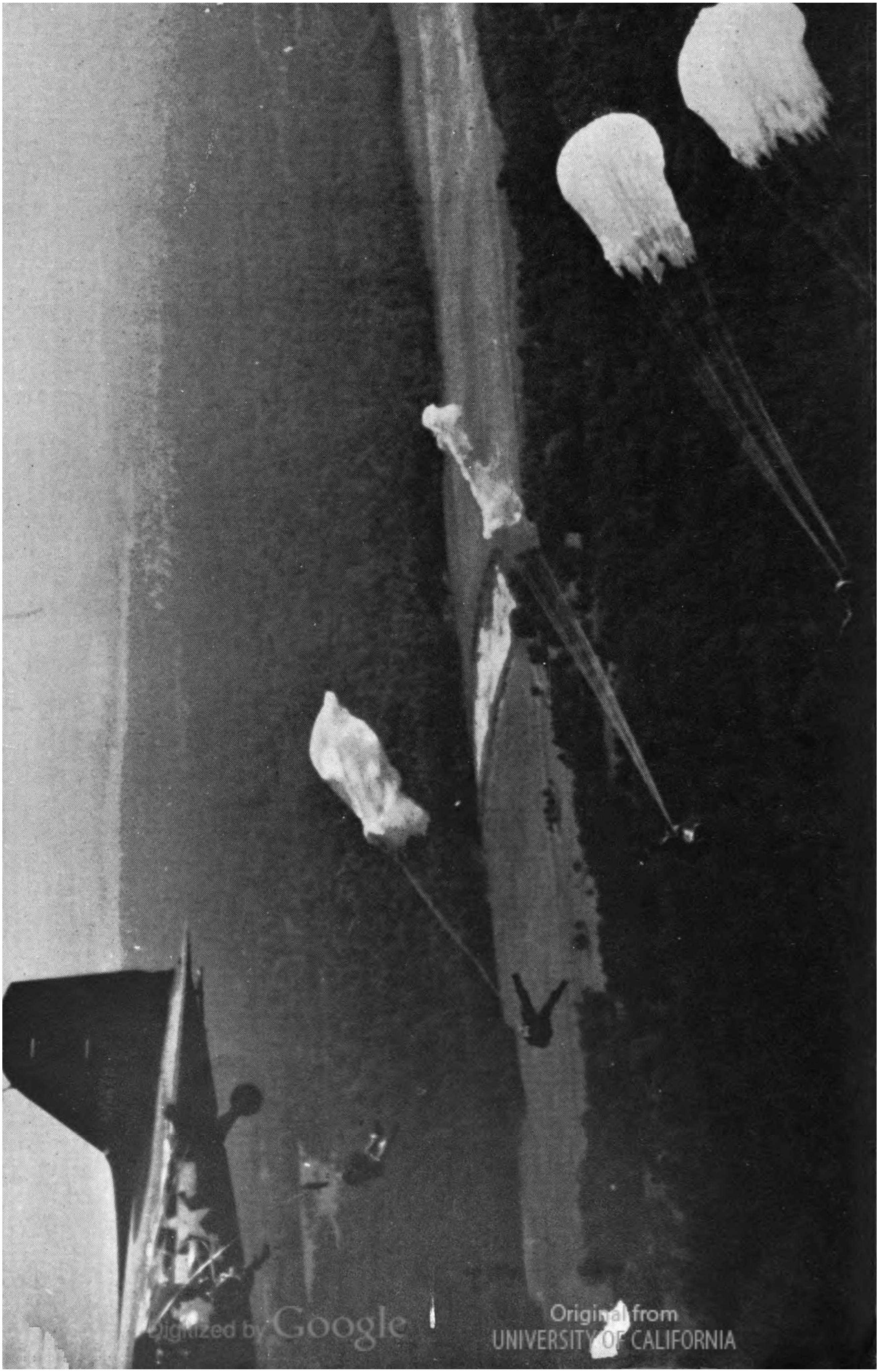
At the outbreak of World War II, Germany had three, if not more, complete paratrooper regiments at her disposal. How she used them is a matter of history. Parachute troops played an important part in the capture of the Wagram Airdrome in March 1938, by occupying the airfield and clearing it for the landing of plane transport troops and thus preparing the way for the fall of Austria. In Poland parachutists dropped in the rear of the Polish lines, blew up bridges ahead of the retreating troops and spread demoralizing rumors. Reports have it that young Polish boys brought up in Germany and promised good jobs as "military circus acrobats", were trained instead not only as parachutists but as saboteurs and aided much in the campaign against their own country. Other reports indicate that the Germans, after their occupation of Poland, cleared several towns of their inhabitants and here carried on secretly through the winter of 1939 and spring of 1940 intense and practical parachute practise.

It is certain that paratroops were important in the capture in May of 1940 of Waalhaven Airdrome in Holland, preparing the way for the landing of an estimated eight to twelve thousand airborne German troops and the ultimate fall of Rotterdam. More parachutists, dressed in Dutch uniforms to add to the confusion, functioned in the action at Mordijk Bridge, and still more were involved in the attack on the Hague. Although the attack was a failure, nevertheless it accomplished much by weakening the adjacent countryside.

An almost simultaneous landing by glider and parachute opened the German campaign in Belgium, which followed within the same month. In possession of Fort Eben-Emael, troop carriers

INVASION OF CRETE BY GERMAN PARACHUTE TROOPS

GERMAN PARATROOPERS IN ACTION IN HOLLAND



again landed reinforcements and eventually took their objective. Meanwhile, the new form of invasion had had a double-edged effect. Not only were paratroops proving themselves in actual attack, but, due to the strangeness of this type of maneuver and various questionable expedients like dressing paratroopers in enemy uniforms and dropping dummies instead of men, they had become ogres before whom the civilian population cringed.

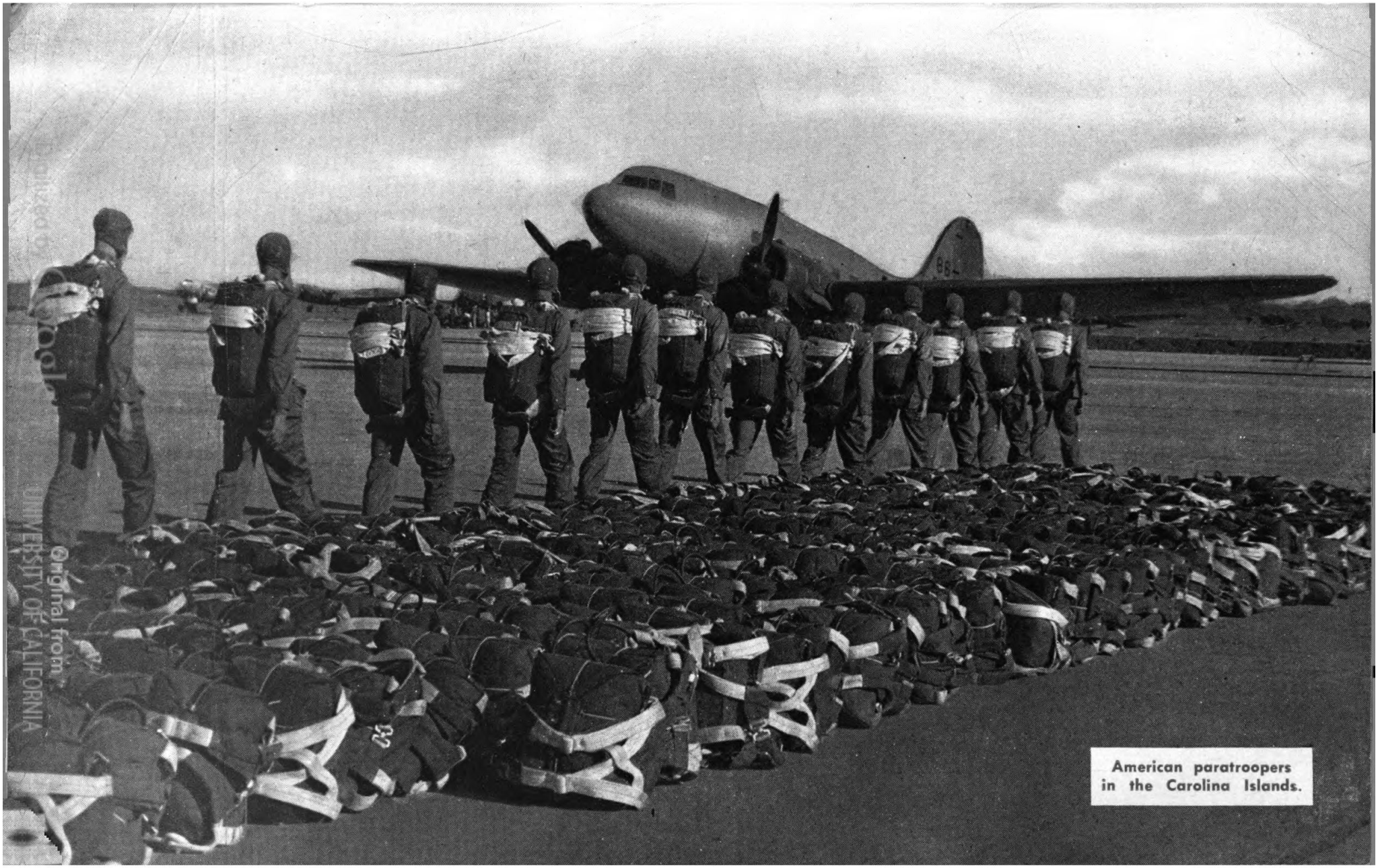
The expansion and development of her airborne troops after Holland enabled Germany to use as many as twenty-five to thirty thousand of them in her attack on Crete. Trained originally, it is supposed, for an invasion of England, these paratroops were able to make three separate landings in Crete easily. In each case they prepared a key airdrome for troops brought later by glider and plane. In Crete was demonstrated for the first time the full effect of a completely coordinated maneuver involving land, sea and air forces all acting simultaneously and toward a common goal.

England, profiting though tardily from the painful example being set her, got her first paratroopers into action only in February of 1941. The place, Mount Vulture, Italy. The objective, to destroy reservoirs and communications. This first venture, so far as we know, met with questionable success. In the spring of 1942, parachute troops aided enormously in two British surprise attacks on occupied France and were important in the conquest of the island of Madagascar.

These were but experimental beginnings. The Allies began to make full use of paratroops with the opening of the African campaign the following November. The paratroops were in the

thick of it from the beginning. American paratroopers under the command of Colonel E. D. Raff flew all the way from England to jump into the fight at Oran on November 8. More American paratroopers landed at Youks Les Baines, November 15.

Paratroopers have also seen much action in the Pacific theatre. Early in 1942 the Japanese used a mass paratroop attack to further their conquest of Java. Island landings have since been successfully accomplished by American paratroopers.



American paratroopers in the Carolina Islands.

THOSE "MEN FROM MARS"

America's paratroop training program was launched, unofficially, as far back as October of 1928. At the instigation of General Mitchell, six armed parachutists dropped from a Martin bomber over Kelly Field, Texas. They assembled their equipment, set up a machine gun, and, within three minutes, were ready for combat. This demonstration, so significant now, was then regarded merely as another stunt. The examples of Germany and Russia were not then apparent.

As America apprehensively watched the global war grind nearer and nearer its shores, the uses to which both her potential enemies and allies were putting trained parachute troops could not be ignored. In May, 1940, America set up an official paratroop training program at Fort Benning, Georgia. With this small unit as its core, the first U. S. Parachute Battalion, the 501st, was formed in October of the same year, and new equipment to further and enlarge training facilities was ordered. The 502nd Parachute Battalion, and the 503rd soon followed. By early spring of 1942, America had her first ski paratroopers on active maneuvers. During the summer of 1942, a large number of American paratroopers were training in England in preparation for the African Campaign.

The group that landed in Africa during the early days, found itself separated from the main body to which it had been assigned, and was unable to carry out its ordered mission. This particular group straightway joined instead with the Fighting French and British who were on hand, and, fighting as infantrymen, routed a Nazi armed column southwest of Tebessa. They took over a hundred prisoners. There are other similar stories, indicating that paratroopers have figured importantly in the South Pacific area and Alaska.

The paratrooper is one of the elite of a fighting force. Germany says it with words: "You are the chosen ones of the German Army." America says it with gratitude and pride . . . and extra pay! Except for the Air Corps, American paratroopers are the highest paid soldiers in the world. Their rating is equivalent to that of Specialists First Class. In addition to the pay belonging to that classification, they receive fifty dollars a month extra "jump pay".

The paratrooper's right to extra pride and extra cash is actually less obvious and less dramatic than it may seem. He is indeed a specialist. His ability to jump and land by parachute is the result of special training. Jumping and landing under battle conditions present unique and real hazards, but they are the least of the risks he must run. His real test comes after he has landed. Then he is no longer the specialist. He is a general fighting man, who must be able to turn his training and equipment to whatever task he finds awaiting him. All of the tasks involved in a successful surprise maneuver require ingenuity, skill and high courage.

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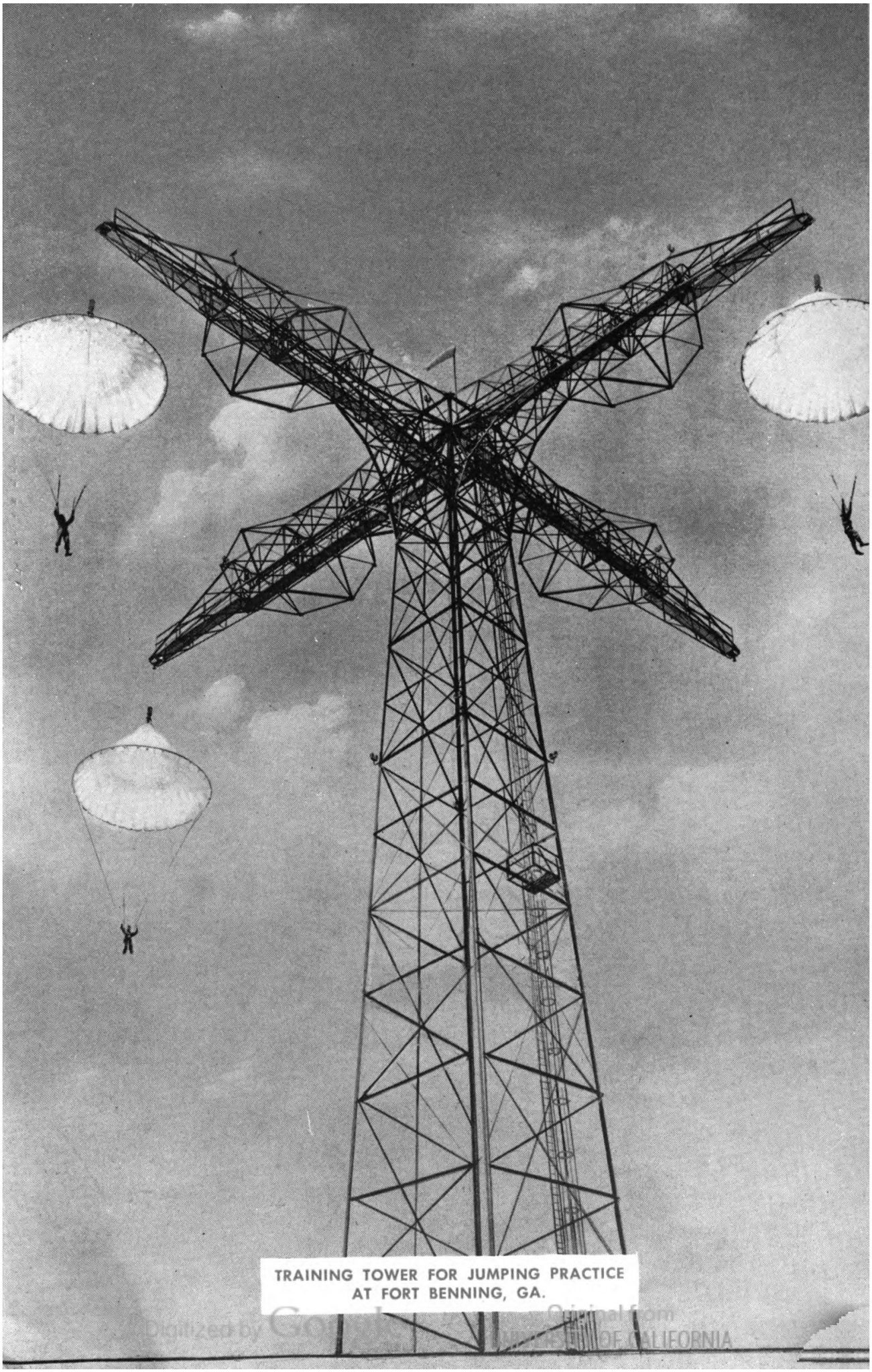
America is training paratroopers by the thousands. All three branches of the Armed Forces have their training camps, Army, Navy and Marines. Basic training methods differ somewhat, and so do primary objectives.

Because of the special hazards in his profession, the paratrooper is a volunteer. We do not intentionally require our fighting men to out-risk one another. Since the conditions under which he must fight may not always be predictable, only men with either six months' training at a regular army camp, or with previous military experience are accepted.

Physical requirements are high. A candidate for paratrooper training is almost without exception under thirty. His company officer may be thirty-five, his battalion commander forty. A young, tough body and calm nerves are a great asset in parachute jumping. The candidate in addition must have normal blood pressure, perfect vision and a sound heart. He must be at least five feet tall, not more than six feet two. He must weigh one hundred eighty-five pounds or less.

Since he is already a veteran of the armed forces, a record of his previous activities and reactions is available. Whatever it is that enables him to jump may prove present or lacking at any step along the training route. It may fail him during his initial ground work. It may freeze him at the cockpit door. Because this lack is unpredictable and final, every paratroop trainee is automatically conceded the right to refuse to go on with his training at any time. His failure is neither publicized nor criticized. He is merely transferred to a more congenial branch of the service.



TRAINING TOWER FOR JUMPING PRACTICE
AT FORT BENNING, GA.

The ratio of those who fail or are otherwise disqualified, compared to those who succeed, is very low. The glamor built up around paratrooping attracts many. It offers exceptional opportunities for brilliant valor and adventure. Both the rigid requirements and ultimate danger serve to discourage those who are temperamentally unfit. The course of training itself is so planned as to eliminate along the way the few unsuitables who do pass the preliminaries.

The first call for volunteers took place in the spring of 1940. No definite training procedures had as yet been established. In actual experience of mass parachute jumping, America had only the findings of the smoke-jumpers of the U. S. Forestry Service. In addition, though, she did have the knowledge of Russian, German and British programs, their mistakes and successes.

The first American unit consisted of forty-eight enlisted men. Equipment was makeshift. For its first jumping practice, this pioneer platoon journeyed to Hightstown, New Jersey. There were the two one-hundred and twenty-five foot towers from which had been developed the jumping towers at the New York World's Fair. Progress was fast and sure. By the time the first battalion was officially formed, new barracks, classrooms, jumping platforms and training fields were under way. Two new training towers, two hundred and fifty feet high were constructed at a cost of some $120,000 each. As the program progressed, this equipment was duplicated in other parts of the country, and the training program became more or less standardized.

A strenuous and thorough program, it includes complete instruction in the parachute itself, how it is made, operates, how

to pack it, repair and store and carry it. It covers the use of many different types of weapons the paratrooper may be called upon to use — grenades, automatic rifles, machine guns, explosives, wire cutting instruments and demolition tools. Giving instruction in the fine points of group action and surprise maneuvers, the program teaches the reading of military maps and the interpretation of aerial photographs. During a stiff course in physical training, much like a football squad's basic training, the candidate learns how to fall without being hurt, to regain his equilibrium almost immediately, and is generally toughened for the job ahead.

All this is on the ground. For his first actual jumping, the trainee advances to the platforms. Jumping first from heights as low as five feet, later from ten feet or more, he learns to relax his body completely as he falls, elbows in, feet together, knees bent, somersaulting when he lands. Then he advances to still higher jumps, which he makes in parachute harness. He acquires the feel of the straps and becomes accustomed to the inevitable jolt when the lines become taut and the harness jerks against his shoulders and thighs.

His first leaps from the training towers are made in much the same manner as were the jumps sold the public at the New York World's Fair. At Fort Benning, a training tower is equipped with four steel arms extending horizontally from the center top. From each of these, a parachute can be lowered or raised at will, its descent controlled by mechanically operated cables and its oscillation checked by guide lines. When using one of these parachutes, the trainee sits comfortably in a sort of swing chair. Shock absorbers cushion his contact with the ground. Because it

is a tame beginning, it gives the candidate valuable opportunity to rid himself of any apprehensions and to observe closely what is happening to him. After five parachute rides, he is eager for the next step.

His progress is painstakingly slow, with the training officer watching every move he makes, checking, correcting and ordering him to repeat until he has mastered exactly the proper technique. Still using the controlled chute, he jumps wearing the harness, but without artificial means of cushioning his fall. Accomplishing this satisfactorily, he goes to the next tower for his first free jump.

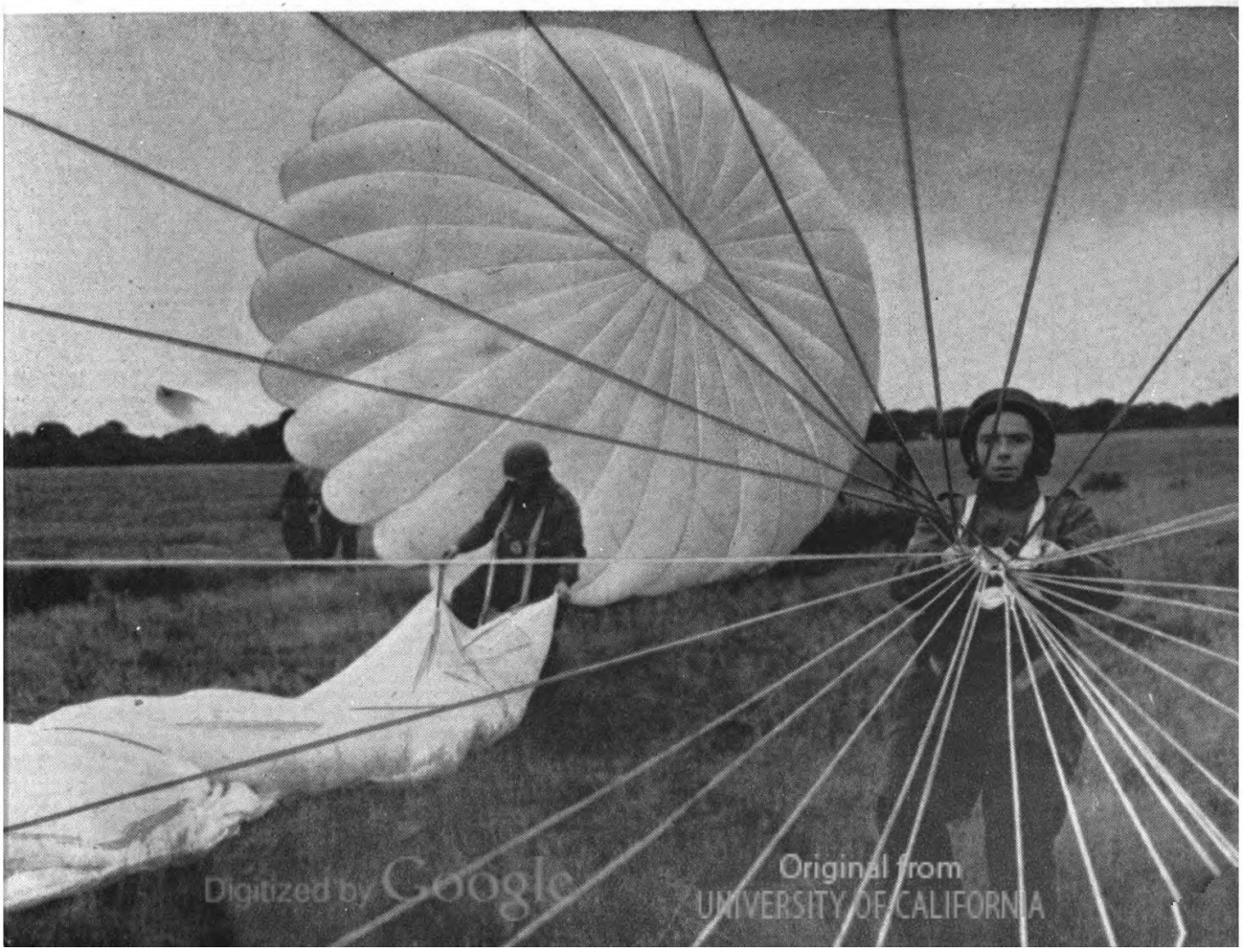
Standing on the ground, he dons his harness, is pulled aloft, and at the proper moment his parachute is released. There are no strong cables overhead, no guide lines to "steer" his chute. He learns how he must function to control it, to land facing the wind, to spill the treacherous air out of his canopy once he is on the ground.

The candidate is at last ready for his first real jump. He knows his chute inside out, knows the worst about the opening shock. He is familiar with the sensations of falling and landing. Nevertheless, his first jump from a plane is anticipated with mixed sensations.

The hour approaches. He climbs into familiar paraphernalia, the olive-drab coverall, zippered up the front. It's a good suit, built of material that won't snag or rip easily. It bulges with pockets which hold weapons, tools, ration kit and other battle equipment. His boots are tall and stout, lined with sponge rubber to take the shock out of the landing, the uppers reinforced to

THE TRAINEE BECOMES ACCUSTOMED TO BEING IN THE AIR

LEARNING TO COLLAPSE THE CHUTE ON GROUND



avoid sprained ankles. On his head he fastens a special plastic helmet, well padded, with a small cushion to protect his chin. Finally, he snaps on his harness with its two parachute packs, one on his back, one on his stomach. He's done all this before. This time it's different — he's going to jump!

A large transport plane carries him aloft. It's a group jump. Twelve men, sitting in two rows facing each other, are commanded by two officers. The trainee looks at his pals, the men with whom he has been in close contact for six weeks of training.

The alarm bell rings! The plane is maneuvering for position. The jump is just ahead! The two rows of men stand up, hook their static lines to the steel wire running the length of the ceiling, adjust their helmets and their harness, feel the snaps and buckles. The cockpit door is open, letting in a cold rush of air. The roar of the motor suddenly dies. . . .

The alarm bell shrills a longer blast! "Go", shouts the commanding officer. He jumps, the first one out of the plane. "Go", shouts the first man, spilling out after him. Only a second apart, the rest follow. Now the trainee is at the door. Below . . . there isn't time to look!

Every muscle schooled for this minute, he finds himself out and falling. Automatically he counts — one thousand, two thousand, three . . . If the canopy doesn't open at the end of three thousand, he's supposed to pull the rip cord of his emergency chute. A familiar jerk tells him the canopy is open. He swings a bit at first. Gradually, his canopy steadies overhead, his fall settles down to an easy glide, through silence and thin, clean air. Suddenly he's very happy. He's done it . . . he's jumped!

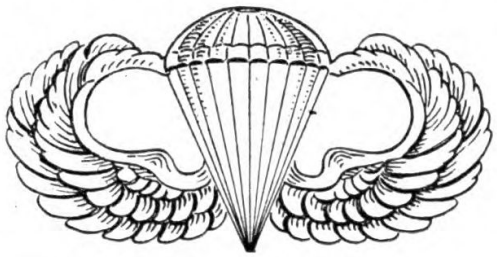
He jumps five times before he can consider himself a real paratrooper. His first jump may be from fifteen hundred feet, later jumps from altitudes as low as two hundred feet. He is closely observed at all times, so that his mistakes may be corrected in future jumps.

Young as they are, American paratroopers have already built up traditions. The most familiar of them stem from the birthplace of the American paratrooper program at Fort Benning. One is the famous cry of "Geronimo", which Fort Benning graduates use as a jumping cry. The mind plays strange tricks during moments of exceptional strain. One of the earlier Fort Benning trainees had gone to the movies the night before his first jump. "Geronimo" was the name of the picture. "Geronimo" was the word his mind led him to shout as he left the plane.

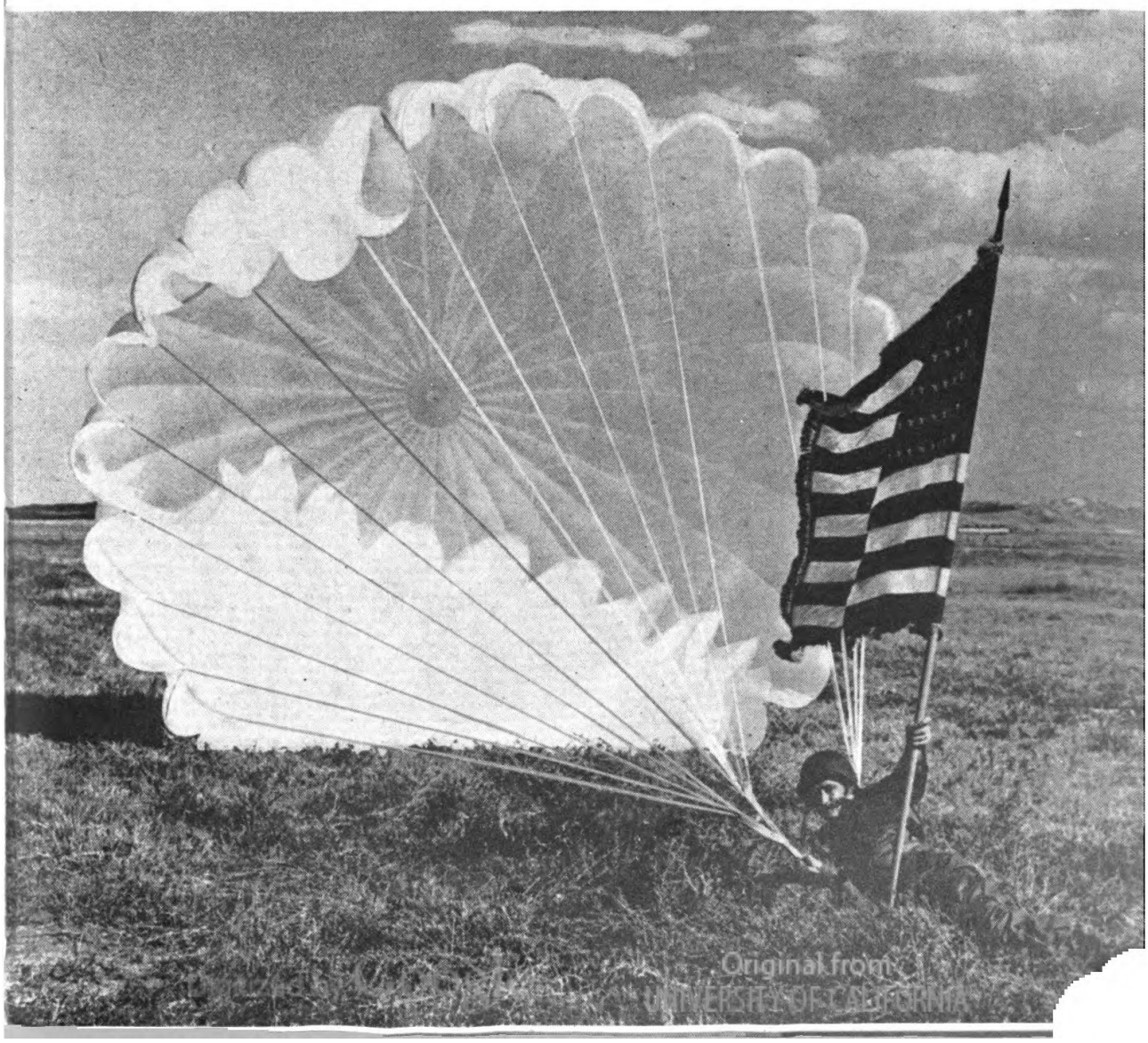
Other traditions have gathered around the battered hulk that is the Fort Benning dummy, Oscar. Oscar is practically a human being. It's Oscar who risks his stumpy life over and over again, to prove that new parachutes are safe for the rest of them. It's Oscar who, when the weather is not ideal, makes the first jump, to tell how hard and which way the wind blows. A great guy, Oscar! It is customary at ceremonial dinners to place Oscar in a position of honor at the head of the table.

Upon the successful completion of his graduating jump, the candidate becomes at last a full-fledged paratrooper, entitled to advertise his new estate by pinning on his uniform the official paratrooper insignia. It is a realistic insignia, a silver parachute with wings extending on either side. After he has made his first jump in battle, the wings may be tipped with gold.

He wears the insignia with justifiable pride. Around that silver parachute has grown up the most alluring tradition of all, a tradition of exceptional stamina, ability and courage. It unites its wearer with the heroes of all time. The American Paratrooper is indeed among the elite of the world's fighting men!



THE OFFICIAL U. S. PARATROOPER INSIGHIA



MEET TODAY'S PARACHUTE

The principle upon which the parachute operates is simple, as are its basic parts — the canopy, suspension lines, harness and pack. Simplicity is highly desirable. The fewer mechanical complications, the surer is its performance, even in the hands of

a novice; the easier such essentials as mass production, the vital operations of inspection and repair.

The conditions under which the parachute must operate are both complicated and variable. To meet them, certain safety factors are necessary. The canopy must open positively and speedily under all conditions. Every part must be strong enough to eliminate any possibility of failure in fabric or construction. The ideal parachute is the one which provides all essential mechanical features without undue sacrifice of simplicity.

The twenty-four foot flat circular parachute, standard today, achieves this combination better than any other parachute yet devised. Its size permits a rate of descent compatible with safe landing. Its design minimizes oscillation, at the same time permitting some degree of control.

Its canopy may be made of pure nylon, usually a glistening white. Sometimes, to camouflage the parachutist against a summer landscape, it is dyed a mottled brown and green. When not camouflage but quick and sure recognition is necessary, the panels may be alternately pure white and bright red, so it can be seen against a field of snow.

The fabric is one of the strongest made. Like every other material used in a parachute — metal, webbing, the thread with which it is stitched — the nylon is manufactured to meet rigid Air Force specifications. It is tested to be sure it meets the specifications under conditions and methods evolved by the government.

These tests are concerned principally with strength. The tensile strength of a fabric is determined on machines that exert increasing pressure until the breaking point is reached. The pres-

sure necessary to reach that point is meanwhile recorded on an indicator.

The maximum strains put upon various parts of the parachute in action are known. At the moment the canopy snaps open, the air pressure at the vent is likely to reach a thousand pounds! The tape used to reinforce the vent must show that it can take a strain of three thousand pounds without breaking. Every other material used in the standard military chute must be equally capable of fulfilling the maximum duty which may be demanded.

The inherent strength of a parachute is not apparent; other strength and safety factors are. These are the details of design and workmanship, which, though small, contribute enormously to all-over efficiency. The standard twenty-four foot canopy, consisting of twenty-four panels or gores, resembles in shape the sections of an umbrella. Each panel is made up of four separate pieces of cloth, the entire canopy consisting of ninety-six individual pieces. These gore sections are cut on the bias, with the warp or lengthwise thread running at a forty-five degree angle to the center line of the panel. The bias cut has several advantages. Should the canopy tear in use, the rip cannot run more than a few feet in any direction before a seam stops it. Still more important, the bias cut increases the natural elasticity of the cloth. The give as well as the inherent strength enables canopy cloth to withstand the terrific strain of the opening shock.

To give the necessary strength, the diagonal seams joining the four sections of each panel are full-felled; that is, four thicknesses of material and no raw edges. These seams, moreover, are wide enough to take two rows of stitching with a three-eighths

inch channel between them. They are made on a power machine driving two needles at once. Like all canopy seams, they are sewed under tension, so threads will not break as the canopy fills with air and stretches taut.

The seams, running from skirt to vent to join the panels, are also full-felled, approximately an inch wide and sewed with a four needle machine. Between the outer and inner rows of stitches, the space is exactly one-quarter inch. Between the two inner rows is a wider channel five-sixteenths of an inch. The suspension lines run through this channel. Experiments with stronger threads indicate that these seams may in the future be made with two instead of four rows of stitching.

Suspension lines are also made of nylon. For additional strength, the lines are continuous from the skirt, up the side of the canopy, over the vent and down through the matching channel on the opposite side. In a twenty-four panel canopy there are twelve separate pieces of line. To make sure each piece is exactly the same length when the canopy is in use, all are cut under tension. To permit absorption of the strains set up as the canopy opens, they are for the most part loose in their channels.

These strains are greatest at the points where the line enters the channel at the skirt. For this reason these points are specially reinforced. Where the suspension line enters its channel, it is held by several inches of stitching. Not ordinary stitching, but double zigzag, in which the needle penetrates the fabric once on each side of the suspension line and once through the line itself. This type of stitching will stretch without breaking.

For six inches above the first zigzag, the line runs free in

its channel. Then come several more inches of zigzag. In addition, where each suspension line enters its channel appears a little V made of nine-sixteenth inch tape. Securely stitched both to the suspension line and to the skirt at either side of the point of entrance, the V distributes the strain among three points, instead of concentrating it at one.

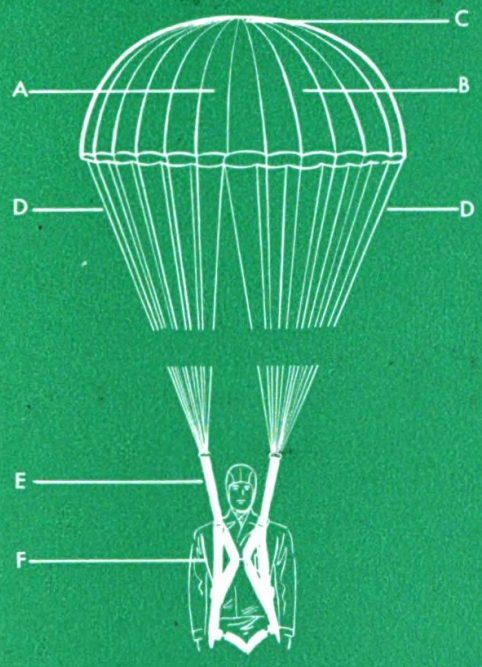
For further strength, both vent and skirt are reinforced with strong flat nylon tape. At the vent is a three thousand pound tested nylon webbing secured to the fabric with four rows of sewing.

At the top of the main canopy is fastened the small pilot chute which facilitates its opening. The pilot chute is in general constructed in the same manner as the main canopy, but is only thirty-six inches in diameter. Unlike the main canopy, however, it is opened by four steel ribs, which operate on a compression spring and spread the minute they are released. The pilot chute is attached to the main chute at the point where the suspension lines meet over the vent, by means of a strong cord.

To attach the canopy to the jumper, the suspension lines are divided into groups, each group tied in zigzag to a link or D-ring which, in turn, is attached to the free ends of the harness webbing, termed "lift webs" or "risers". Harness webbing, usually cotton one and three-quarter inches wide, has a tensile strength of three thousand pounds -- five thousand in some of the more recently designed webbings.

The principal element of the harness is a loop made by stitching thicknesses of webbing together to form a sling or swing in which the wearer sits. For the rest, it consists of those addi-

tional straps which are necessary to maintain the sling in proper position on the body and to prevent the wearer from falling out. To facilitate putting the harness on and taking it off, these straps are fastened as necessary by steel fittings, so arranged and so constructed that it is impossible to cross the leg straps or to fasten them incorrectly. Since parachute harness usually comes in standard sizes only, adjustment to the wearer is made possible by adapters installed on the back straps and adjusters on the shoulder and leg straps.



A — CANOPY, B — SINGLE PANEL, C — VENT, D—SUSPENSION LINES, E—RISERS, F—HARNESS.

A PARACHUTE AS WE KNOW IT TODAY

This drawing shows the principal elements of a parachute, when opened. The canopy, made up of 24 panels, is attached to the harness by the shroud lines. These lines, fastened in groups of six to the riser straps, run from riser, up over the canopy, down to the opposite riser. Vent at top regulates release of air.

Manufacturers and Army Officials inspecting parachutes at Fort Benning.

The meticulous care with which the harness is constructed is evident in every stitch. At every place where the webbing is joined, stitches run not only crossways of the webbing, but diagonally and horizontally as well. All cut ends are paraffined before they are turned under and stitched, to prevent any possibility of fraying. Fasteners and snaps operate with strong steel springs. To prevent any outside contact from opening them by mistake, they are applied so that the mechanism which opens them is next to the body where it can be operated only by the man wearing it.

The exact design of the harness varies with the type of pack. The design of the pack likewise varies somewhat with its type and according to whether it is opened automatically or with the rip cord. In basic principle, all types are the same.

The seat pack, used by the Air Force, may be considered typical of all packs for the free-type parachute. It consists of a canvas pack, the body made semi-rigid with a wire frame. On the opening side are four large flaps shaped to fold over and cover the contents completely. One pair of these flaps has three phenolic stiffeners, which are inserted and function much like corset bones. On the inside botttom of the pack are two rows of retaining loops. When a parachute goes into its pack, it does so in reverse order to that in which it emerges. Thus the suspension lines are the first to be put into place. The retaining bands hold them in carefully divided bundles, keeping them from fouling and allowing them to slip out easily as the canopy pulls at them.

This is the minimum pack, the skeleton. To perfect it required dozens of additional details. Every raw canvas edge is bound with tape. Flap corners are turned in, to form pockets into which the packing tool can be slipped for easier packing. Somewhere on every pack there are two pockets in which must be carried cards bearing the parachute's identification, its service, test and repair record.

In packing, the pilot chute goes in last. To give it separate lodgings and to aid its spring into the air, two of the pack flaps are furnished with inner flaps. When the main canopy is folded in the pack, these flaps are laid in place, the folded pilot chute laid above them and the main flaps folded over the top.

The most interesting parts of the pack are those which assure its positive and quick opening. One of the four top flaps is provided with two or more locking cones, cone-shaped pieces of metal, shaped and polished, provided near their peak with an eye. The three remaining flaps have either metal grommets or ring tabs which, as the pack is closed, fit over the cones. The cone is shaped to permit the grommet or ring to leave it on the slightest persuasion. As long as it is supposed to stay in place, it does so because of metal locking pins passed through the eye of the cone. Each locking pin is in turn fastened to a flexible metal cord.

This is the rip cord. It ends in a metal grip shaped to be grasped easily in the hand and large enough to take a hand plus a heavy glove. Its length depends upon the position in which the pack is worn. On front packs, the grip just emerges from the flaps. On seat and back packs the rip cord is longer, so that

Makers at Fort Benning studying the paratrooper maneuvers.

the grip is located at the left thigh where the flier can reach over with his right hand and grasp it easily.

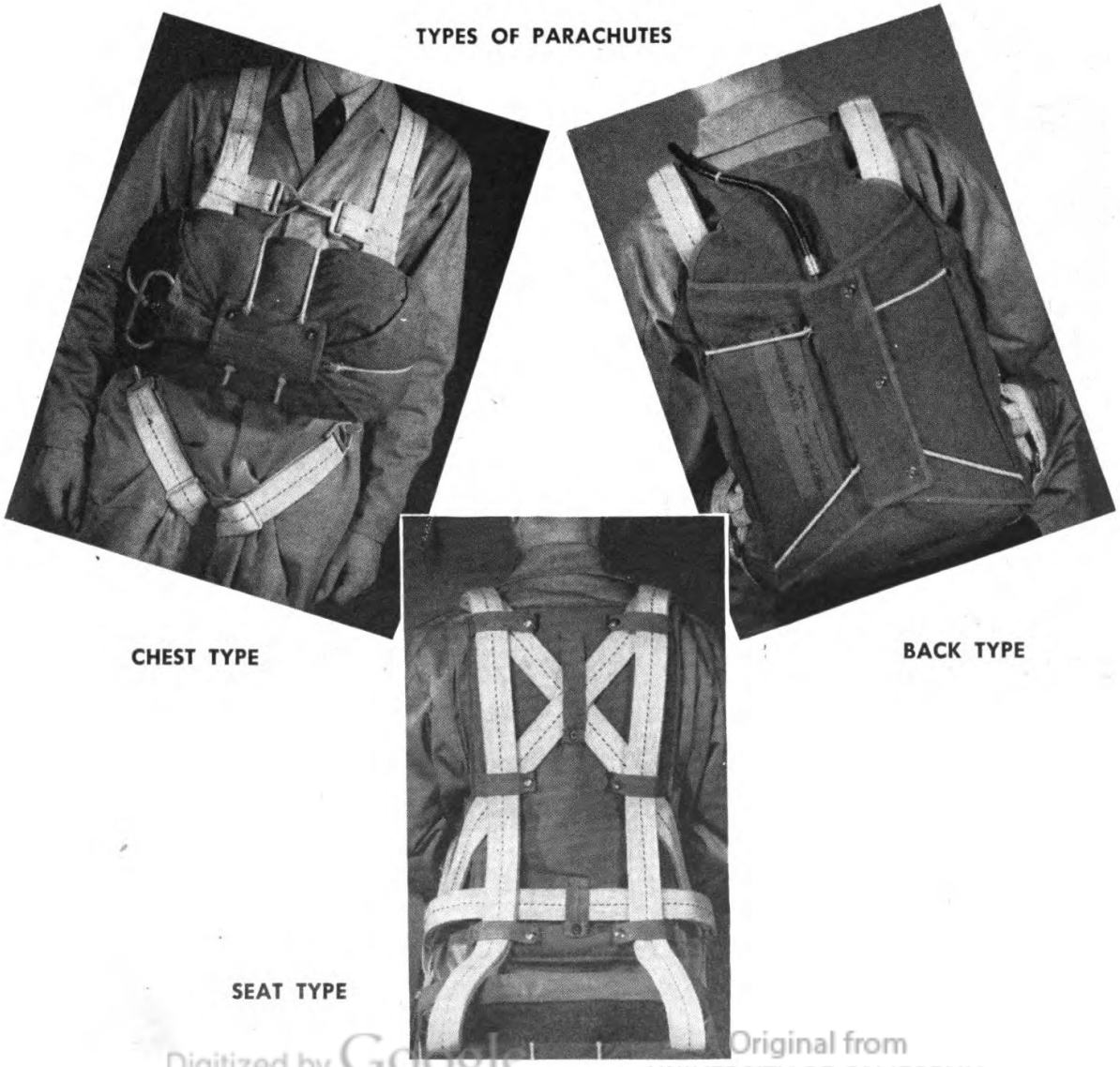
Once the rip cord is pulled, it must release the pack completely and instantly. To guarantee release, each flap is equipped with strong elastics, which pass from the locking edge around the entire pack to hook onto it at the opposite side. Stretched, it is under maximum tension. The instant the rip cord is pulled and the cones are free, these elastics not only snap the flaps open, but spread them wide.

Until the rip cord is pulled, it is equally important to keep the pack shut. Where it runs along the top of the pack, the rip cord is protected by its own special housing. This consists of two more flaps, strongly reinforced and securely locked over the rip cord by dot fasteners. These are much like the round snaps found on plackets, and envelope pocketbooks. The only difference is that they must be lifted at the exact point marked by a little white dot, or they refuse to open. Unless the flier wishes to open it, the housing remains tightly locked. When the rip cord extends outside of the pack, it is further protected by a flexible metal tube to shield it from any contact which might accidentally release the chute. As a final safety factor, once the parachute is in its pack, and the locking pins are inserted in the cones, they are tied in place by a break cord, not very strong. A jerk on the rip cord will break it. Until the jerk comes, it does prevent any small jar from pulling the locking pin out of its eye.

When the parachute is the automatic type, pack opening is a slightly different problem. In this case, the static line which connects the parachute to the plane is folded into holders on the

outside of the pack. The pack is closed by fitting into the opening provided for it, an oblong canvas cover. It is fastened there by lacing it with a cord run through metal eyes in both the pack and the cover. The static line is attached to the pack in such a way that when the flier jumps, all the strain is put on that oblong cover. The lacing cord is a break cord, with a tensile strength of a hundred pounds. The minute the weight of the jumper bears upon it, the cord breaks, releasing the cover and permitting the canopy to be pulled out.

TYPES OF PARACHUTES



CHEST TYPE

BACK TYPE

SEAT TYPE

WHEN LIFE HANGS BY A THREAD

Brave men tend to joke about bravery. As a result, the paratrooper early developed his own particular brand of humor. He has a habit of decorating his training helmet with frivolous inscriptions — and advising the raw recruits that the parachute is guaranteed, a new one if it doesn't work!

The life of a paratrooper is dangerous. As he himself knows after only his first jump, the danger is actually less in the jump than in what comes after. His life is comparatively safe as long as it is dependent on his parachute. He can rely on the 'chute!

That he has such confidence is by no means a matter of chance. It is the result of long experiment, of rigid control in

every step of manufacture, of testing, and re-testing. Nor does this control apply only to the finished parachute. It covers every piece of material, every fitting that goes into it, down to the very thread. When life may literally hang by that thread, it must be worthy of its assignment.

Control, and the means of applying it, did not come into being overnight. When this country's large-scale parachute program was launched in 1940, the standardization which holds today did not exist. The Army and Navy had been testing parachutes since 1919. Parachutes for commercial and civilian use were tested by the Civil Aeronautics Board, which also accepted for approval models tested and approved by the Army and Navy. The findings now prove invaluable in the formulation of the standard specifications which immediately became essential to a successful program of mass production.

In that program, another factor played an important part. There were in this country, in 1940, only a small number of companies equipped to manufacture parachutes. It was a special job, requiring special machines, special materials and specially trained operators.

The need for mass production came at a time when it was already difficult to secure new equipment, and too late to rely on unskilled operators hurriedly trained. In emergency, the government turned to those who were partially equipped to do the necessary work. Many of the companies manufacturing parachutes today are comparative newcomers in the field. Until the last two or three years they were making underwear, dresses, shirts and other articles of clothing. Now their sewing machines,

expert seamstresses, and years of experience are proving invaluable in the mass production of a necessity of war.

One of the first to enter the field was the Reliance Manufacturing Company. Established forty-five years ago, this company had become known as the maker of Big Yank work clothes, Happy Home and Kay Whitney frocks, Ensenada slacks and sportswear, Aywon dress shirts, Universal pajamas and No-Tare shorts. It is this country's largest manufacturer of garments.

Early in 1940, Herbert G. Mayer, president of the Reliance Manufacturing Company, offered the services of his company to Materiel Headquarters, Wright Field. If war came to this country, what could Reliance, with its background and equipment, best do to help? The answer was obvious: parachutes!

Though equipped only with tentative drawings and specifications, hard put to secure the necessary materials, Reliance made up a small number of sample chutes, submitting them for qualification testing.

Qualification testing is a routine procedure for any manufacturer that wants to make parachutes under government contract. It is the means by which he proves to the government that he is properly equipped to turn out a product that can be accepted. He does this by submitting samples of the parachute he proposes to make, together with drawings and specifications, complete with certified records of all tests made in the process of manufacture. Through these, with performance tests, he must convince the Procuring Agency not only that the product conforms to official directions but that it lives up to his claims. If the product proves completely satisfactory in all respects, the

manufacturer becomes eligible for government contract.

There was the difficulty of procuring materials at first. Few were available in the quantity and exact type required, because they had been hitherto manufactured on definite and limited order only. Metal parts are today produced swiftly and exactly on machines which automatically perform all necessary processes. Since the dies from which these parts were cast were unavailable in 1940, Reliance located rough forgings, and finished them by hand.

INSPECTING AND FOLDING CHUTES

The first samples were completed, drop tested, and submitted to the Engineering Branch at Wright Field for final examination and testing. They were pronounced among the finest samples ever submitted by a new manufacturer!

Reliance entered the parachute business!

That was in October, 1940, one year and two months before Pearl Harbor. At Fort Benning, the first paratrooper unit of the U. S. Army was being formed. In January, 1941, Reliance received an order for ten thousand parachutes, to be delivered at the rate of four hundred a month, starting in March, increasing to sixteen hundred a month by June. The company changed its rather modest plans overnight. By February, six hundred operators were at work! By the first of June, four thousand parachute canopies were ready for the harness, and about six thousand packs ready for their frames and delivery!

What this achievement involved is difficult to imagine. It involved the opening, cleaning, painting, repairing of a plant in Washington, Indiana. It necessitated the assembling of all available equipment — all that could be spared from the company's other plants — together with as much new equipment as could be secured.

Machines that sew parachute cloth are highly intricate. The old machines had to be re-adjusted to meet the exacting demands of their new job; the new machines often required major operations to put them in working order. Repairmen and operators were scarce. It was a matter of assembling every available worker, of re-training many to the new techniques, of adding unskilled workers who had to be completely trained.

Stitch inspection and sewing panels for parachute canopy.

Sewing the colored aerial delivery chute.

Meanwhile there was the ever-present problem of specifications — still in a stage of transition. From the beginning, these specifications have imposed strict limitations on the manufacturer, and they are even more strict today.

All parachute materials are manufactured under government control and according to government directions. The manufacturer knows that they have met certain tests. Nevertheless, final and official testing is still his own responsibility. He takes no chances . . . Every lot of canopy cloth, tape, suspension line, hardware, every spool of thread that comes into his factory begins its career there by being tested again!

Such testing requires special equipment and trained personnel, in addition to manufacturing equipment and operators. The testing continues throughout the entire process of manufacture. All stitching is examined by an expert over a fluorescent light panel. One stitch over the edge, the entire section is rejected!

One of Reliance's earliest problems was the setting up of a technical staff to institute training and testing procedures. Through this staff was developed much of the equipment and methods which have been since universally adopted for parachute manufacture. Its part in the perfecting of the modern military chute is considerable, as will be its influence in the perfection of an all-purpose parachute for civilian use after the war.

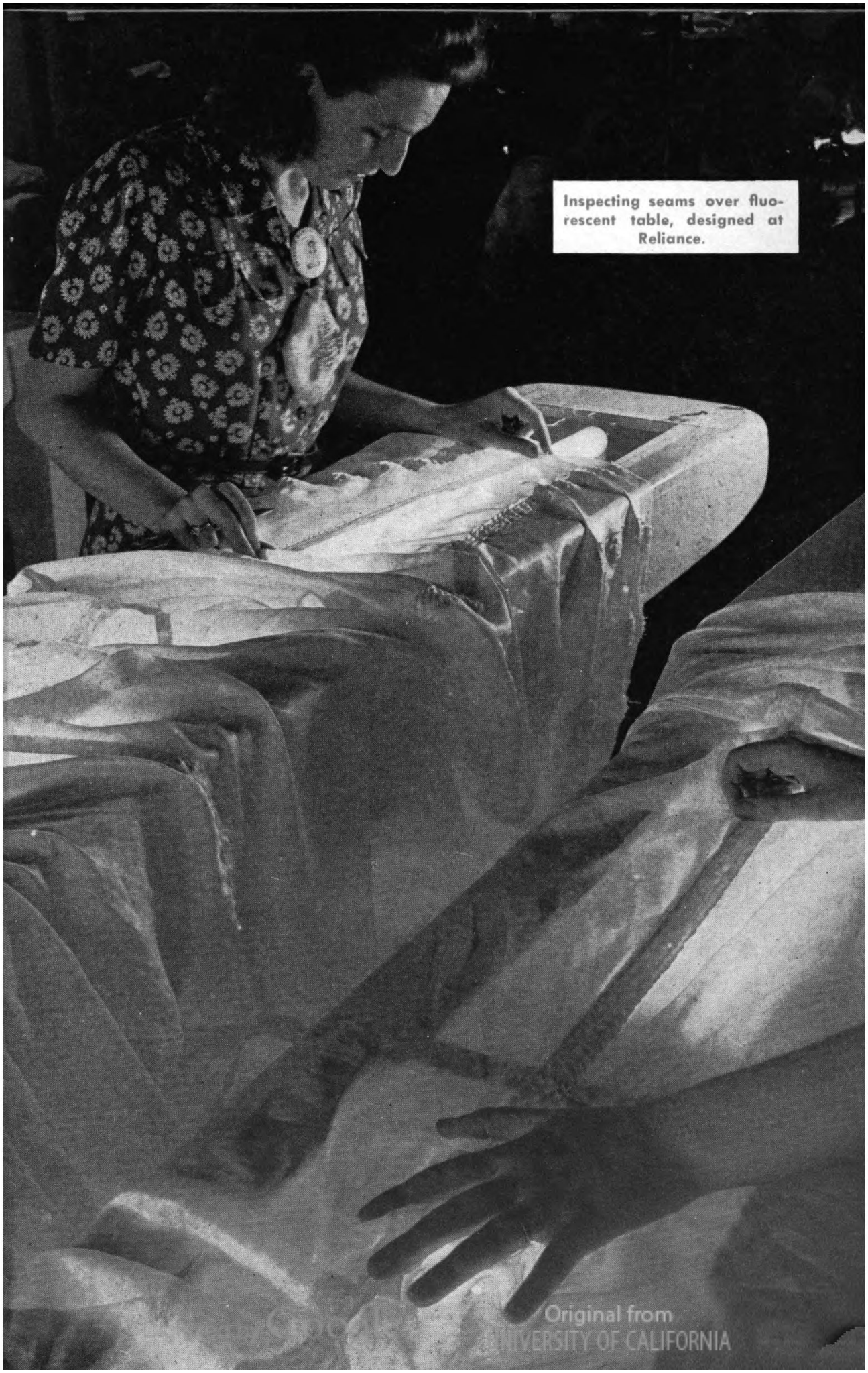
When a parachute is finished, its testing days are by no means over. The fact that the government has given the manufacturer an order does not automatically imply that it will accept his product. Inspection testing is the means by which the manu-

facturer proves that he is maintaining the standard of perfection for which his contract calls. To establish this proof, he must drop-test a number of parachutes out of each contract delivered.

For its drop-testing, Reliance secured the services of a number of pilots and planes. It built its own airports, one at Washington, Indiana, another at Columbia, Mississippi, site of an established Reliance plant also making parachutes.

Over the Washington airport, in the early days, parachutes were flown daily to the prescribed height, and dropped. The first summer brought an unexpected complication. The Indiana grasshopper found the white silk canopy irresistable. The grasshopper's "tobacco" quickly disintegrated the fabric, since he discharged it in great quantities when he was lost among the folds. Many entire gores had to be replaced. Reliance hired an "anti-grasshopper" squad. The minute a load of parachutes was dropped, the squad rushed over the fields in trucks, recovering the canopies, and removing the grasshoppers before any damage was done!

The parachute dummy is a very important factor in drop-testing. To date, the only way to know how a parachute will perform is to take it up in the air, and drop it. To duplicate as closely as possible the conditions it will meet in service, it is dropped with a weight approximating that of the average man. The dummy is shaped like a man, except that it has no head and arms, and only part of its legs. With it, the manufacturer makes the preliminary drop tests which help him perfect the samples he must send for qualification testing.



Inspecting seams over fluorescent table, designed at Reliance.

It is small wonder that the parachute dummy has assumed almost human qualities — even to the extent of having a name.

Reliance originally called its dummy "Elmer". Later, after a world-famous parachute jump that will go down in history, the dummy was re-named: "Rudolph". The hero at Wright field is "Dummy Sam", at Randolph Field, "Buck Private Dummy", at Fort Benning, "Oscar".

For the drop test, "Rudolph" is snapped to his parachute and taken aloft. If the test plane is an Army bomber, he may make his jump ignominiously by being released from one of the bomb racks. In other tests he may be more humanely dropped from the door. In any case, his jump is from around five hundred feet, with a plane speed of one hundred miles per hour and up.

These tests reveal to the experienced eye most of the necessary knowledge regarding a parachute. Opening time can be checked, as well as mechanical performance. The rate of descent can be timed, and the wear and tear of use observed to a degree.

More subtle problems are harder to solve. An occasional misplaced suspension line, a canopy that turns inside out, can be corrected only by the experienced jumper who is able to observe what happens when jumping. No dummy can perform this job. The knowledge gained by test jumpers, working with unproven equipment may be very costly. Many attempts have been made to devise a mechanical means of opening a parachute so that its performance can be observed at close hand. Wind tunnels have been used for this purpose, also a testing tower with a swinging boom.

In inspection testing, the dummy is leading man. If he shows a single parachute to be imperfect, the manufacturer is in trouble. If its failure seems to the government inspector to indicate that either material or workmanship do not conform to specifications, the flaws must be determined and corrected. An entire lot may be rejected because the one parachute tested to represent it, failed to function properly. The Procuring Agency has the right at any time, even before inspection testing, to request one sample of each type of parachute for testing under actual service conditions.

Everything is held up at the factory until the results are in, and the manufacturer is told to resume production.

It was in June of 1941 that the Reliance Manufacturing Company shipped its first consignment of parachutes. The following November brought another order for parachutes of a type so different from the first, that a second plant at Washington, Indiana, was opened. The whole routine of preparing the plant, equipping and manning it was repeated. Soon the grim fact of actual war brought additional orders, necessitating even greater expansion.

Today, the Reliance Manufacturing Company is using three out of its twenty factories in the manufacturing of parachutes. Two of them are at Washington, Indiana, one at Columbia, Mississippi.

The number of chutes it is producing, the number of people at work on them, is military information that cannot be divulged. However, Reliance is today the largest manufacturer of parachutes in the United States. It is producing human chutes for

paratroopers, pilots, gunners and bombardiers; aerial delivery and cargo chutes for the Army and the Navy. Reliance parachutes are in use all over the world!

The parachute saved its first life in this country when Lt. Harold R. Harris bailed out of a wrecked plane over Wright Field in 1922. Lt. Harris became the charter member of a notable organization, called the Caterpillar Club. The Club's membership includes all who had saved their lives in emergency jumps with a parachute.

The number of men who must thank a parachute for their lives has swelled immeasurably. Those who owe their lives to Reliance chutes have an organization of their own, the Reliance Parachute Club. Membership is designated by a silver pin with red, white and blue bars, and a white parachute over all. It marks the wearer as one who has had one of life's most thrilling adventures. In so marking him, it also proclaims a special meaning for what has been long a proud company slogan:

"You can RELY on RELIANCE!"

General MacArthur inspects paratrooper's equipment prior to an attack against the Japs in New Guinea. *(Note — Reliance chutes all over the world.)*

for

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